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AGRICULTURE IN INDIA.

The Department of Agriculture in India has been in existence, in its modern form, approximately since 1905. To all agriculturists and scientists who have watched its progress during the last decade, it has been increasingly evident year by year that an astonishing amount of sound work was being accomplished; and this has now been made clear to the non-technical man-in-the-street by the publication of a review of the agricultural development which has taken place in India since the Department of Agriculture was organised on its present basis. This Review,* concisely and interestingly written by MR. J. MACKENNA, places before the reader the chief problems of each of the main crops of India and shows what has been, and is being, done to solve them.

Perhaps the most useful feature of the Review, to other countries, is the series of deductions and conclusions which MR. MACKENNA draws from the experiences of all who have attempted to effect improvements in Indian agriculture. For the Department of Agriculture was not the first agency in the field. As in other parts of the British Empire, agriculture had been considered a subject on which every man, by virtue of his descent from ADAM, had an inherited right to authority, and money and energy had been periodically expended on spasmodic and ineffectual efforts. But those efforts at least provided object lessons which have been taken full advantage of in the organisation

* Agriculture in India by J. MACKENNA. Price 25 Cents.

of the present Department. It is now recognised that progress must be based on research, and until some research has been accomplished, a Department of Agriculture has little of sound value to offer.

In the current number of this Journal we have quoted at considerable length the main outlines of the Review referred to. One is tempted to go further, and quote the many refreshingly vigorous aphorisms, the result of experience, by which MR. MACKENNA enunciates the fundamental principles of agricultural investigation. But we refrain, in the hope that all of our readers who are interested in the furtherance of Agriculture will acquire the pamphlet and discover those principles for themselves.

T. P.

SORGHUM *(SORGHUM EXIGUUM F. MAXIMA)* IN NORTH AFRICA.

— TRABUT.

The sorghum called in the United States "Sudan Grass," and "Tunis Grass," and which comes from Khartum and Algiers, is very nearly related to the wild form *Andropogon halepensis* with which it has been confused, although different in several characters. Thus, while the Aleppo sorghum has spreading rhizomes which form a coarse dogs-grass much disliked by cultivators, *Sorghum exiguum* does not spread and its stem is straight and of small diameter, thus justifying the name of *Holcus exiguus* under which it is described by FORSKAL in the *Flora Aegypto-arabica*. The inflorescences are sometimes very reduced, as in the Egyptian type, or large and diffuse. The spikelets are always jointed, and are easily detached when ripe.

In Kabylia, the writer observed a very tall variety called "Mezza" by the natives, which seems to mark the transition to the cultivated forms, although it undergoes no modification when cultivated.

Sorghum exiguum f. maxima is well suited to southern climates and to more or less arid soils; on damp soil, or one that is irrigated, it can yield at least two cuttings. It grows well in association with a leguminous plant; with *Dolichos Lubia* or with *Soja*, sorghum has given good results. The grain is easily harvested; it is only necessary to cut the ripe inflorescences and expose them in a dry place; then when they are shaken, the seeds which are previously enclosed in the glumes at once fall out, as in the case of the broom sorghum and the sugar sorghums.

Feeding experiments have shown that no bad effects are produced if the sorghum is cut after flowering, and fed to cattle 24 hours after being cut.

—BULL. INTERNAT. INST. OF AGRIC.

RUBBER.

LABOUR AND RUBBER CROPS.

ALL IN COSTS AND TAPPING SYSTEMS.

We have repeatedly pointed out that the two factors which will materially influence the ultimate crop from plantations are those of labour and diseases. It is evident to all who are conversant with Eastern affairs that the labour problem is becoming much more acute, and that large acreages which are fit to tap are not being exploited as in years gone by. We know of many instances where thousands of trees previously in the tapping line have been temporarily abandoned in consequence of scarcity of labour or diseases and pests. There is no doubt that if the labour difficulty increases the effect on crop will be apparent. We have had a long connection with the tropics, and we are quite sure that the labour difficulty will always be with us. The publicity given to labour troubles at very frequent intervals has tended to make many planters and directors regard agitations for the improvement of labour with less interest than might have been expected.

The problem has been made more difficult by the restrictions imposed by the Indian Government with regard to recruiting Tamil coolies for various parts of the tropics, and also by the recent legislation in the Dutch East Indies, limiting the period for which coolies can be recruited from Java. Unfortunately these steps by the respective Governments have coincided with a very large increase in the demand for labour consequent on the increased acreage to be tapped, and the increase in size of trees previously in the tapping round.

Ceylon is feeling the pinch very keenly, and one need only refer to the Agricultural Bulletin of the F. M. S. to see how serious the question of recruiting, crimping, and the arrest of absconders is becoming in Malaya. In all these countries the costs of recruiting have gone up, and also the average daily wage. In times like the present one is prepared for increases, and they cannot therefore be regarded as unexpected. The more serious difficulty lies in the fact that the actual supply from Java and India is by no means up to the requirements.

COOLIES PER ACRE.

Opinions differ as to the number of coolies per acre required on rubber properties, and certain variations must be allowed for in view of the fact that all rubber estates do not consist of one product only. Where tea or coffee is concerned (as is the case with many rubber properties) still more coolies are required, per acre, when these particular products are interplanted with Hevea, and not on separate acreages. We have made a study of the number of coolies per acre on various estates from the figures given in various annual reports. There are several estates which manage to get through their business with even less than one cooly per four acres. In one remote colony a particular company has to be content with one cooly for every eight acres, which is admittedly insufficient. The majority of estates are using one cooly

for every two to three acres, and from the figures before us we should say that the average estate now requires one cooly for every 2½ acres.

In the course of years the demand for labour for certain estate works such as weeding, changkolling, and so forth, will be less, but on the other hand more labour will be required as the recently planted areas attain maturity, and as the trees now being tapped increase in age. We think that on the whole still more coolies per acre will be required than at the present time. It is this cardinal fact which makes one view the labour position with great anxiety. There is not the slightest doubt that if the position does not very rapidly improve, plantations in the Middle East, and also in the West Indies, will not give us their maximum output.—INDIA RUBBER JOURNAL.

PLANTATION RUBBER IN COCHIN CHINA.

LAWRENCE P. BRIGGS.

(Continued from p. 287 Vol. XLVII.)

GETTING POSSESSION OF THE LAND.

After deciding on a location, the next step is to get possession of the land. Theoretically, the Government of Indo-China permits the acquisition of domain lands by gift or by auction sale under certain conditions of cultivation.

Free concessions apply only to tracts of 50 hectares or less. Application must be made on stamped paper to the Administrator-in-chief of the province in which the land is located, indicating clearly the location of the land, its approximate extent and boundaries, and enclosing a rough sketch of the tract. In the case of tracts exceeding 10 hectares, the application must also be accompanied by the fee for the administrative enquiry, which fee is uniformly 20 cents (about 10 cents United States currency) per hectare. The application is then registered and a receipt signed by the administrator is returned to the applicant. Then for two months the administration posts notices of application (1) on the land, whose boundaries should be marked by the applicant; (2) at the town hall of the village where the land is located, and (3) on the door of the office of the administrator of the province. At the end of the two months the application is delivered, together with the report of the native authorities and the protests of third parties, if any, to a special investigating committee composed of the following officials: the administrator-in-chief of the province, president; the chief, or under-chief of the canton, and two notables of the village. If the land is located in a forest region, an agent of the Forestry Service is added to this committee. The applicant, the owners of the adjoining property and the occupants of the tract, if any, are duly summoned and sign the official report (process verbal) formulating in it all observations and reservations which they consider necessary. When informed by the administrator of the conclusions of the committee the applicant, if he accepts, deposits with the administrator a map of the land and an official report of its location and delimitation. These reports and documents are sent to the governor of the colony, who, if he approves, will put the applicant in possession of the land. The applicant must establish his domicile on the plantation, or at the seat of the province, and must put

Kilogram=2·2 pounds. Hectare=2·47 acres. Franc=23·8 cents. Piastre=about 50 cents.

the concession under cultivation, within three years in the case of concession of 10 hectares or less and within five years in the case of 10 to 50 hectares, under the penalty of forfeiture of all or part of the land granted. If at the end of this period all the conditions have been complied with, the holder of the concession is granted a definite title to his land.

In actual practice, however, no rubber estates of any consequence are ever granted gratuitously in French Indo-China. In the case of tracts of more than 50 hectares the land is sold at public auction. Application is made in the same way as for a free grant, and the notice is the same, except that it must also be published for two months in the BULLETIN ADMINISTRATIF of the colony and the MONITEUR DES PROVINCES. A similar committee meets and fixes the price of the land and other costs. The applicant may establish his residence at the capital of the protectorate instead of either of the places mentioned in the preceding paragraph, and the reports and specifications (*cahiers des charges*) must be approved by the Governor in Council. After approval notice must be given, from 15 days to a month in advance of the sale, by placards printed in French and in the native language of the district, naming the day, hour and place of the sale. These placards must be posted (1) on the door of the office of the administrator of the province, (2) at the Town Hall of the village, (3) at the Town Halls of neighbouring villages and (4) in the Government Offices at Saigon. Notice must also be published in the BULLETIN ADMINISTRATIF and the MONITEUR DES PROVINCES. All persons wishing to bid on this land must deposit a sum equal to one-fourth of the minimum price when this amount exceeds 100 piastres, which sum will be returned to all except the successful bidder. All terms, conditions and reservations are fixed by the specifications (*cahiers des charges*) signed by the investigating committee and by the applicant or someone holding his power of attorney. The purchase price is paid by the successful bidder in two instalments—one within 20 days of the sale, the other a year later. Upon the fulfilment of all the conditions of the *cahiers des charges* a definite title is granted by a special decree of the Governor in Council. The price paid in the past for rubber lands sold at public auction has varied from 50 cents to 5 piastres per hectare.

In the case of rubber lands, all grants, whether by free title or by public auction, are made under certain conditions of cultivation. In all grants up to 500 hectares, one-tenth of the grant must be planted each year with at least 120 rubber trees per hectare, so that half the grant is under rubber cultivation at the end of five years, under the penalty of forfeiture of all or part of the estate. This time is extended to ten years in the case of grants exceeding 500 hectares. For the remainder of the concession the holder may leave it in waste land or pasturage or plant it to rice or other cultures. But a definite title will not be granted until half the plantation is under cultivation. An administrative committee visits each grant in November of each year to see that all these terms are complied with.

For the first seven years a rubber grant is exempt from land tax. At the beginning of the eighth year one-tenth of the estate is subject to the impost levied on the first class of "various cultures" (2·75 piastres per hectare), and the uncultivated half is subject to the impost on the third class of various cultures (48 cents per hectare). After the tenth year one-half of the estate is subject to the first class tax, the other half to the third class tax.

All these terms and conditions are applicable to foreigners under the same conditions as to French citizens or colonists.

Rubber lands, planted or unplanted, may also be purchased of private individuals from time to time. During the past year several small plantations were offered for sale. The foreigner should be wary about purchasing a small estate, for rubber production in the past has been largely an experiment and there has been some reckless tapping, especially on the smaller plantations. The larger estates are generally held by joint-stock companies. Their shares are sometimes offered for sale by the notaries of Saigon through the columns of the local papers and especially those of the "Bulletin Financier de l' Indochine." At present it is practically impossible to purchase stock in the better plantations.

A few cases may serve to illustrate the prices at which these plantations have been sold or offered for sale during the past year. The most important deal in rubber plantation property since the beginning of the European war was the sale in May, 1915, of the plantation of Tan-thanh-dong. One of the leading stockholders of this firm was a German ; so the firm was dissolved and the property sold. The amount received was 225,000 piastres. This was considered a very low price; but the sale took place before the phenomenal rise in the price of rubber and under conditions which may have restricted the number of bidders and limited the amounts offered. In November, 1915, a small plantation near Saigon was offered for about 30,000 piastres. This plantation consisted of 450 hectares, of which 150 hectares were planted with 50,000 trees a little more than five years old and ready to be tapped, a nursery containing more than 150,000 young trees and some timber and buildings. While these cases may have some significance, they do not indicate the prices at which the best rubber plantations are now held.

CLEARING AND PLANTING.

Some of the older plantations were located on cultivable or prairie land; but in the red soil region the clearing of the plantation is a more serious problem. The vegetation is tropical and dense, and the stumps and roots must be removed or in the moist, hot season they will furnish a hotbed for mould and other plant diseases. In spite of the cheapness of native hand labour (10 to 20 cents per day), the clearing of a plantation sometimes costs as much as 25 piastres per hectare [over $5 per acre]. However, the vegetation is less dense, the rainfall less constant and the cost of clearing less expensive than in the more tropical climate of neighbouring rubber producing countries.

Before the plantation is ready, a small tract of land is prepared as a nursery. Here the seeds are planted, generally toward the end of the rainy season (September to January). The young plants are sheltered from the sun during the dry season and at the beginning of the rainy season (May or June) they have attained a height of 1·50 to 1·80 metres (5 to 6 feet) and are ready to be transplanted. Holes are dug 80 centimetres to 1 metre (32 to 40 inches) in depth and wide enough to accommodate all the roots. On the earlier small plantations the trees were planted very close together. The larger plantations—Xatrach and Suzannah—at first adopted 4½ by 5 metres; but this distance was found too small, and the latter plantations have generally left a space of 6 or 7 metres between trees.—INDIA RUBBER WORLD.

(To be Continued.)

CACAO.

CACAO IN ST. LUCIA.

The export of cacao in 1915-1916 was 18,478 cwt., valued at £51,495. This shows a very satisfactory increase of 4,245 cwt. during the year.

Owing to the increased attention that has been paid to the development of the lime industry during the last few years, there was some danger of the cacao industry becoming neglected. The statistics based upon the export returns given in the Blue Book show, however, that a steady increase in the cacao production of the Island has been maintained.

This steady increase is partly due to the extension of the area cultivated, and to the improved methods of cultivation followed on many estates. Root diseases has, in some instances, been a blessing in disguise; it has caused closer attention to be paid to the tillage of the soil, necessitating extra drainage and liming, which have in almost every case proved of great benefit to the surrounding trees.

LIME.

Our leading planters are fully alive to the great benefits derived from thorough drainage and the free application of lime. If all cacao growers throughout the Island, including peasants, small proprietors and estate holders would thoroughly drain their cultivations and apply a good dressing of slaked lime, followed by thorough mulching, our annual exports would be greatly increased.

Where this advice has been put into practice and then followed up by mulching, the results within a short time are astonishing.

There is no valid reason why established cacao should be neglected for the cultivation of either limes or coconuts; there is ample room in St. Lucia for all three and many other remunerative crops. Every effort should be made to maintain a balance in the crops grown and so prevent the island from becoming once again dependent on a single industry.

CACAO CANKER.

This serious fungoid disease of cacao is far too prevalent in many cacao cultivations, and it does not appear to be receiving the necessary attention to keep it under control. The fungus enters a tree through minute wounds and cracks in the bark. To the experienced eye canker can be recognised in ts early stages by a peculiar dry, greyish-brown appearance. Later it is apparent to all by what is known as the "bleeding stage," when the affected parts split and a brown-red gummy fluid is seen exuding. The bark of these patches upon being cut presents a deep claret colouration, and the tissues are moist.

Apart from the profuse flowering exhibited by so-called "male" trees, cacao trees are sometimes seen to be abnormally covered in blossom. This is often a sign of the presence of canker, and any cacao tree flowering sufficiently to attract special attention should be carefully examined for disease. The fungus generally extends in an upward direction. Should the fungus girdle the trunk, the tree quickly dies. When a number of canker patches

appear on the trunk and stems, the leaves become smaller, turn yellow, and the tree gradually dies. Canker can be kept under control by carefully cutting out all the diseased area with a sharp knife, tarring over the wounds, and *burning all infected material removed from the trees.* Varieties of cacao vary greatly in their susceptibility to canker ; some varieties exhibit moderate resistance, while others, such as Criollo, readily succumb to it.

ROSELLINIA ROOT DISEASE.

This disease, caused by the fungus *Rosellinia Pepo*, for which no cure has been found once a tree is attacked, at one time seriously threatened the cacao industry of the Island. It has now, however, been brought under control so far as the leading estates are concerned, and no apprehension need be felt for the future as the necessary treatment for the successful control of this disease is well understood, and immediate action is taken by planters as soon as a case is observed. The position in regard to the smaller estates and peasant holdings is not so satisfactory. In many of them the disease still thrives unchecked, and a large amount of work remains to be done in cleaning up such diseased areas and thereby removing the source of infection to the larger estates. Trees found to be suffering from root disease should be immediately cut down, every root removed from the soil, and the whole tree cut up and burnt—if possible in the place where it grew. A heavy application of lime should be made in the hole, and to the soil around.—ST. LUCIA AGRICULTURAL DEPT. REP. 1915-16.

TREE-FELLING BY MACHINERY.

A demonstration of tree-felling by machinery took place in February last near Stirling, Scotland. The machine used was a No. 2 tree-feller guaranteed to fell any tree up to 48 inches in diameter. It was designed by MESSRS. A. RANSOME & CO. The machine was supplied with steam from a 7 nominal horse-power traction engine through a 120 ft. length of patent metallic steam hose covered with felt and canvas. This length allows all the trees within an area of about 1 acre to be felled without shifting the boiler. Though the ground was covered with snow, sufficient steam was kept up to run the machine at full speed.

Three trees, tough oaks of an average diameter of 46 inches, were felled in about 13 minutes each. Under normal conditions, trees varying from 42 to 43 inches have been cut in from 6 to 8 minutes, and spruce in about half the time. In the course of the demonstration it took 4 or 5 minutes to shift the machine, which is fitted with removable wheels, from one tree to another.

Usually a small portable 4 nominal horse-power boiler which can be easily moved by one horse, is supplied with the tree feller. The advantage of the traction engine is that it can drag the trees where required after being felled.

The machine accomplished in a few minutes the work which would have taken two men four or five hours.

The trees were all felled at the ground level, and the clean cut made by the saw adds to the selling value of the timber, apart from the saving of wood. Only two men are required to work and shift the whole outfit. With the machine an interchangeable frame is usually supplied by means of which the trees can easily be cut to any required length after they have been felled.—

BULL. INTERNAT. INST. OF AGRIC.

TOBACCO.

GROWING WRAPPER TOBACCO UNDER SHADE.

In the PHILIPPINE AGRICULTURIST AND FORESTER for June, 1916, are recorded the results of interesting work done in the production of cigar wrapper tobacco under shade at the College of Agriculture in the Philippines. The object of the work may be considered as the testing under shade of the native Cagayan, Tirona Hybrid and the acclimatized foreign varieties—Turkish Lowland, Vuelto Abajo, Sumatra, and Texas Cuban—to find out in a preliminary way what their respective possibilities are in the production of wrapper leaves under Philippine conditions, as compared with leaf produced in the open field.

The cultures were located on a very slightly inclined piece of ground by the Molawin River, some 40 feet above the river level. The soil is rather heavy and had never been used before for tobacco, although other crops such as rice and sugar-cane had been cultivated on it ; and the mere fact that it is not specially adapted for growing wrapper markedly served to show the effect of the cheese-cloth cover.

The seed used in the present work was obtained from the varieties above mentioned, the object of including so many varieties being to find out which ones would profit best by shade culture, and which would not. The seeds were sown in carefully prepared wooden flats in September 1915, and the seedlings transplanted into prepared seed beds, in October at distances 4 c. m. apart each way, which proved sufficient for the purpose.

The shade tent was built to cover an area of 774 square metres, or about one-thirteenth of a hectare. The cloth used for cover was not of the special weave in common use in America, but the same fabric as is commonly used in the making of mosquito nets. The area under shelter was divided into six plots varying in size according to the number of seedlings available at the time of replanting. Outside the tent, check plots were laid out corresponding to the number of plots inside.

All the leaves being especially produced for wrapper, harvesting was done by priming, or the act of removing or gathering the leaves singly from the stalk as they severally reach the proper degree of ripeness. Harvesting began in February 1916, and the difference in appearance of the leaves inside and outside the shade tent was so obvious that it seemed as if the outside leaves were ripening earlier ; hence these were primed one or two days earlier.

In the process of curing, the leaves were never exposed to the direct rays of the sun, so that the whole process followed was a cool or natural one. The fermentation was done in Manila because, among other reasons, of lack of room and necessary materials in the College, the course adopted being that of ageing first and fermentation later, which is said to be the method universally practised in America.

As to the effect of shade on the quality of the crop, on the whole, Cagayan and Tirona Hybrid gave the best results, the leaves produced under shade being pronounced as 'equal if not superior to Sumatra but never inferior.' Turkish Lowland, Texas Cuban and Vuelto Abajo gave only fair results. Tables are given, showing that the burning qualities of only Cagayan

Sumatra, and Tirona Hybrid were improved when shaded, and that there is usually a considerable increase in the size of the leaf when grown under cheese-cloth.

There is also recorded a description of work on fertilizer tests of tobacco carried out at the Agricultural College, to which the following conclusions and recommendations are appended: these should be of interest to tobacco growers in the West Indies :—

Conclusions. (1) Looked at from the standpoint of financial returns, the largest gains were obtained from the use of manure alone, Plot (1) and legumes alone, Plot (7).

(2) From the economic stand-point of the Fillipino farmer, green manuring, using cowpeas and other leguminous crops, and animal manuring, using horse manure and carabao dung, furnish the cheapest material for the production of better crops of tobacco.

(3). Systematic and careful application of commercial fertilizers should be carried out by every large grower so as to determine the needs of his particular soil.

(4). All varieties used in the test showed a creditable response in height, vigour, and to some extent, in yield, to the fertilizers applied.

Recommendations. (1) More extensive and careful study in the fertilization work is needed (a) to obtain better production, (b) to determine when the quality of each of the different varieties we have at hand reaches its best, (c) and to some extent, to develop the aroma and flavour of their leaves.

(2). In using any fertilizing material, either commercial or natural, with the aim of increasing the yield of the crop in question, the land should be put in its best possible tilth.

(3). This work should be repeated in all of the important tobacco-growing districts of the Islands.—THE AGRICULTURAL NEWS.

TOBACCO CURING IN JAFFNA.

(*See Frontispiece.*)

The chewing tobacco prepared in Jaffna for the purpose of export to Travancore and for local consumption is cured, by smoke. The process is quick and simple, but it gives the leaves a dark colour which unfits them for any other purpose. As soon as the tobacco is ready for reaping, the cultivator begins to build his curing hut, which is a circular room of about 10 feet in diameter with mud walls of 5 to 7 feet in height, and with a detachable roof of sticks and dry palmyrah leaves. The circular form is adopted with a view to secure the even distribution of smoke and heat. Most of these huts are permanent structures—so far as mud walls can secure permanency—of which the roofs are renewed annually, and are as a rule erected close to the dwellings of the cultivators, often far from the tobacco field. The floor is about 2 or 3 feet below ground level and has a small and narrow entrance which has to be closed when the tobacco is being smoked. Such combustibles as coconut husks and stalks which generate the largest quantity of smoke are spread on the floor and burnt, while the leaves which were cut on the previous day and allowed to wilt are hung from the roof. After being subjected to the process of smoking for about 12 hours—from 6 P.M. to 6 A.M.—they are removed and stacked in a heap outside the smoking room. A day or two afterwards the same process is repeated and the leaves are then ready to be packed in bundles for the market. The smoke rising from hundreds of curing huts hangs like a pall over the villages where this process is carried on, making them well nigh impassable during the curing season.—[C. RASANAYAGAM.]

FRUITS.

LIMES IN ST. LUCIA.

Lime products to the total value of £7,312 were exported during the year, 1915-1916.

The progress made in lime planting during the last few years is now beginning to show in the annual increase of lime products.

Now that separate records of each product are being kept by the Treasury officials, it is possible to gauge accurately the progress made fron year to year.

The actual progress made by any industry cannot be gauged accurately by its total annual value, as this figure rises and falls according to the fluctuations of the market during the period under review. The most satisfactory method is to bring the quantity of concentrated and raw juice exported to a common basis of barrels of fruit. For this purpose it is assumed that 1 barrel of green limes is equivalent to 8 gallons of raw juice, and that 9 gallons of raw juice are equivalent to 1 gallon of concentrated juice.

The lime crop for the last two years, calculated in this way, is as follows:—

1914	...	...	...	12,765 barrels of fruit
1915	...	...	...	21,363 „ „

This shows an increase of 8,598 barrels during the year.

A total crop for the whole island of 21,363 barrels of fruit cannot be considered in any way satisfactory, and it shows better than anything else, what has been repeatedly pointed out, namely, that *lime plants require practically the same degree of care and attention as cacao*, and our exports for 1915 unfortunately prove that from 1902 to 1908 the majority of persons engaged in lime cultivation did not give the trees the necessary attention.

Judging from the number of lime plants distributed from the Department's nurseries alone—and there are many private nurseries in the island—there should be at least 600 acres of fully established lime trees in the island even after allowing the full period of eight years to reach maturity, and making every allowance for natural losses; and our crop should have reached 54,000 barrels of fruit in the year under review.

The chief causes responsible for this unsatisfactory state of affairs were set out and published in a leaflet, and some improvement has recently been observed in the general treatment of lime cultivation in various parts of the island.

Notwithstanding the advice given by officers of the Agricultural Department, limes are still being planted in many instances without any previous preparation of the soil, and without protection from the prevailing wind. Such practice cannot be too strongly condemned. It means a total loss of time, money and trouble to the owner; it creates a scale-infested area which becomes a source of infection to others, and a direct loss of plants and revenue to the Government; and it keeps back the development of the island as a whole. Where limes have been planted without wind belts, temporary belts of pigeon peas should be established to protect the young limes until the permanent belts are acting.

In an island like this, where labour conditions are somewhat difficult it is a sound policy to get 50 acres established as quickly as possible and then increase only at the rate of 5 acres per annum; if our larger estate owners had been content with this policy, our present exports would have been doubled.

Market rates for concentrated lime juice, although not so abnormally high as in 1914, maintained a high level throughout the year, ranging from £28 to £34 per standard pipe. Extension in lime cultivation continues at the rate of about 300 acres each year. To encourage this development, the price of lime seedlings from the Department's nurseries was reduced from 2*s.* 3*d.* to 1*s.* per 100, this being 2*s.* below actual cost of raising.

ROOT DISEASE.

It is satisfactory to be able to record that no case of root disease among lime trees has been observed by or reported to the Agricultural officers during the year. The only instances of root disease affecting lime trees in St. Lucia and recorded by the Department occurred in 1912, when two cases were observed in the Soufrière district. In each instance the limes were in direct contact with other trees (cacao and Immortelle) which had died from the disease. With care and close attention our lime orchards should be kept free of the ravages of this serious disease.

The four common parasitic fungi of scale insects, viz: *Sphærostilbe coccophila*, *Ophionectria coccicola*, *Cephalosporium lecanii*, and *Myiangium Duriæi* kept the scale pests under control wherever the climatic conditions were favourable.

In situations exposed to the full force of the prevailing wind, it is impossible for these beneficial fungi to thrive, and this together with the diminished resistance of the trees accounts for the severe attacks of scale insects found in such circumstances.

THE BUDDING OF LIMES.

In the Report of the Agricultural Department of Dominica for the year 1914-1915, Mr. J. Jones, the Agricultural Superintendent, discussed the question of budding of limes.

As these remarks apply with equal force to St. Lucia, they are herewith published for general information:—

'Had the budding of limes been mooted in Dominica a few years back as a reasonable measure for the improvement of lime cultivation, it is probable that the suggestion would have received scant consideration. It would have been pointed out that the lime was probably the hardiest of the citrus family grown in the tropics; that the use of other species of citrus as stocks for limes was unlikely to lead to improvement while the cost of producing plants would be raised from a few shillings for seedlings per acre to £4 or £5 for budded plants, the latter being a very serious addition to the initial expense of planting new areas.

'This aspect of the situation, once so strongly held, has been modified during recent years. With the extension of the area under limes there has been the usual increase of pests and diseases. However hardy the lime may be when grown individually, or in small areas, it is highly susceptible to root diseases when massed in cultivation, both in dry and in wet districts. To a considerable extent these diseases may be kept under control by a strict outlook, and an efficient system of drainage, but their presence renders it

mportant that trials should be made to test the value of certain stocks for limes with a view of securing immunity from root diseases under sound conditions of cultivation. To this end the budding of limes on Sour Orange stocks was tried some time ago, The Department has now ¾ acres of budded limes in the Experiment Stations, whilst a number of plants have been distributed to estates for trial.

'The selection of Sour Orange for a stock was largely due to the fact that in one district in Dominica in which lime root diseases are prevalent, there exists a plantation of several thousands of orange trees budded on this stock, not one of which has been attacked. Whether the Sour Orange will prove a suitable stock for limes in all respects remains to be seen. The lime is somewhat difficult to bud on to it. On lifting the plants from the nursery beds for transplanting in the field, a small percentage of the scions will die, which tends to show that the union is not altogether a congenial one. Also on this stock there is a considerable tendency on the part of the scion after only a little growth has been made, to flower and fruit. If fruiting is permitted at an early stage, the plants would remain in a stunted condition. From observations to date it would appear necessary to pick off the flowers or small fruits from budded trees, and to manure the stock with a view of getting sufficient growth to form a fair-sized tree before bearing is permitted.

'In the Progress Report for 1913-14 reference was made to the arrival of six small plants from Kew, of a stock used in Morocco for oranges, and said to be resistant to root disease. In that country the plant is propagated by cuttings for use as stocks. It is known by the name of "M" gergeb, and is evidently a variety of citron *(Citrus medica)*.

'The plants received in Dominica have grown well. Considerable progress has been made in striking cuttings, and it is hoped to have at least ¼ acre planted with limes on M'gergeb stocks shortly, as well as to distribute a number for trial in the out-districts.

'It is also intended to bud a number of limes on the common citron for trial. The habit of the citron in spreading by means of throwing suckers from the roots will need to be controlled when used as a stock. This, however, should not be difficult.

'Unlike the Sour Orange, the two last named plants are closely related to the lime. Consequently it is expected that the budding process will be easily accomplished in both instances.

'Those who have had citron plants under observation cannot fail to have noticed the powerful system of surface roots which these plants possess. The question arises as to whether such plants are better able to obtain the supply of plant food from the soil, and to make a fuller use of manures applied in the course of cultivation than plants less favourably furnished with roots. If so, the dense surface root system of the citron should be an important factor in estimating its value as a stock for limes.

'In the search for suitable stocks for limes for use under the varying conditions of climate, it may be desirable as time goes on to experiment with species of Citrus other than those mentioned above. The suitability or otherwise of stocks can only be determined by field trials carefully conducted over a course of years.

'The experiments outlined are necessary and important in the interests of the lime industry. Should it be shown as a result of these trials that the

use of certain stocks secures immunity from root disease, and that the capital invested in lime cultivation is proved to be safer from the constant menace of uprooting during gales to which the lime on its own roots is subject, then valuable information will have been gleaned. The higher cost of budding plants over seedlings, now regarded as practically prohibitive, would under such conditions be amply justified.'

Budding experiments are being conducted at Choiseul, and the lime has been successfully budded on the citron and sour orange stock; plots will be planted up as soon as sufficient plants are available for careful observations as to rate of growth, immunity to disease, bearing qualities, behaviour in drought, etc.

It is not expected that the sour orange will prove totally immune to root disease, as two cases of sour orange trees killed by this fungus were observed in the Fond St. Jacqces district, and recorded in April, 1912, (*vide* Report on the Rosellinia Root Disease of Cacao in St. Lucia, by F. W. SOUTH, B.A., Mycologist, Imperial Department of Agriculture, and ARCHIBALD BROOKS, Assistant Agricultural Superintendent, St. Lucia, Circular No. 2, Imperial Department of Agriculture).

The sour orange is however a deep-rooted stock and more able to withstand a gale; in this connection it may prove very useful for planting in fairly exposed situations, and will probably withstand a severe drought better than the lime grown on its own roots.

The degree of resistance of the citron stock to root disease is at present unknown. Having a much more spreading root system than the lime it should prove very successful in sloping shallow soils.

The spineless and ordinary limes are being used in these experiments.—
ST. LUCIA AGRIC. DEPT. REP. 1915-1916.

A "COPPER LIME" SPRAY FLUID.

It is claimed that a spray fluid cheaper, no less efficient, and of greater adhesive power than ordinary Bordeaux mixture, may be made from copper sulphate and alum, plus freshly prepared milk of lime. The formula for the preparation of this—Martini's solution—is copper sulphate, $1\frac{3}{4}$ lb.; alum, $1\frac{3}{4}$ lb.; fresh burned lime, 2 1/5 lb.; water, 44 gallons. The alum and copper sulphate are dissolved in part of the water. The lime is slaked and suspended in another portion of the water. The milk of lime is added with constant stirring to the solution of copper sulphate and alum until the mixture gives a distinct alkaline reaction with litmus paper. The rest of the water is then added, and the fluid is ready for use. Although it contains only half the amount of copper contained in Bordeaux mixture, it is said to be as effective a fungicide as the latter.—GARDENERS' CHRONICLE.

FOOD PRODUCTS.

THE NUT BUTTER INDUSTRY.

The finest nut butter manufacturing plant in this country (England) is controlled by a famous multiple-shop company, which distributes about 550 tons of nut butter daily among its thousand shops. The machinery is complicated and costly, there is a complete technical and scientific staff to direct operations. From the moment the Copra and the milk enter the establishment to the time when the finished product is packed for dispatch the hand of man touches them not. Nut butter is distinguished from dairy butter by its absolute immunity from microbic contamination, fermentation or other deleterious influences. It is also susceptible to sterilisation, a quality not possessed by dairy butter. The highest medical authorities consider that within a measurable period nut butter will entirely supersede the dairy product, becoming a permanent and prominent factor in the dietary of the people.

In the factory referred to the processes of manufacture are so regular and rapid that milk and Copra, delivered at noon, can be transformed into nut butter, packed and dispatched by four o'clock the same day. Everything is done by machinery—transport of raw material, cleansing and brushing of churns, tanks, etc., packing the finished product. A case for packing 56 lb. is constructed by one machine, which drives twenty nails in two or three seconds, another machine printing and attaching the label, etc.

Every process is carefully watched and subjected to the most stringent tests. The operations being continuous, night and day, two brigades of chemists follow every process. An attractive department is the laboratory, with its magnificent array of scientific instruments and apparatus necessary for the testing of the various ingredients to determine their purity and palatability. Every possible device to secure a perfect product, and every invention to improve the quality of the nut butter is adopted, regardless of expense.—The Pioneer Coconut Manual.

BURMA BEANS.

The edible beans most commonly grown in Burma are varieties of *Phaseolus lunatus*, large quantities of which are exported to the United Kingdom and the Continent, where they are commonly known as Burma or Rangoon beans. Those shipped are of two kinds, small reddish beans, and white ones resembling "small haricots" in appearance. During the course of an investigation conducted at the Imperial Institute on the production of prussic acid by certain plants, it was found that the Rangoon beans, when ground into meal and mixed with water, gave indications of the presence of this poison. In the case of the red beans, the quantity of prussic acid formed was not exactly negligible though usually harmless, whilst the white Burma beans, as a rule, yielded little or none.

So far as is known, no harm has arisen from the use of the beans as a feeding stuff. The export trade in these beans from Burma continues to flourish, but as the yield of prussic acid is variable, the beans are sometimes regarded with suspicion by agricultural experts in Europe; and for this reason they bring, in ordinary times, comparatively small prices in the market.

In view of these facts the Imperial Institute, in consultation with merchants in London, suggested to the Department of Agriculture in Burma that steps might be taken to encourage the natives to cultivate for export a better class of beans suitable for human food. In order to carry out experiments from this point of view, a special experiment station was established by the Department at Natywagon. The Imperial Institute forwarded samples of the large white butter beans (Madagascar beans), which are in demand in this country, to the Department for trial cultivation, and later on two tons of similar beans were forwarded by the Institute for experimental cultivation by Co-operative Credit Societies in Burma. These butter beans belong, like Rangoon beans, to the species *P. lunatus*; but through cultivation they have lost, to a large extent, their characteristic of producing prussic acid, and it was hoped they would retain this cultural peculiarity in Burma. It was also suggested by the Imperial Institute that trials might be made with the true white haricot bean, and a supply of one of the best varieties of the white haricot bean was forwarded to Burma for this purpose this year.

Madagascar beans have now been grown in Burma for three seasons, and the produce has been examined at the Imperial Institute. Although the beans were found to yield somewhat more prussic acid than the original beans, the quantity was negligible, and less than that yielded by the ordinary Rangoon beans.

If the Madagascar beans are found to give satisfactory yields in Burma, and to retain their characteristics of large size and only minute yield of prussic acid, they would be far more profitable to grow than the Rangoon beans. In the case of one sample of Burma-grown Madagascar beans, a firm of merchants in London stated that consignments of equal quality should realise the ordinary price of Madagascar beans, which is about £20 per ton, against £6 per ton for Burma beans. These are, of course, pre-war prices. Samples subsequently received were smaller than the original beans, but it was stated by a firm of merchants that they would realise good prices. At the present time all edible beans command exceptionally high prices.—BULL. OF THE IMP. INST.

CULTIVATION OF TAPIOCA IN TRAVANCORE.

A. PADMANABHA IYER.

In no other part of India is tapioca grown so extensively as in Travancore. An abundant rainfall, a suitable climate, large areas of arable hill slopes, the little need there is here for heavy manuring and easy culture are amongst the conditions necessary for its successful cultivation. These are available to an eminently satisfactory degree in Travancore. The Portuguese were the first to introduce the plant about the sixteenth century into Malabar from its original habitat in South America. It is believed tha its importation

into Travancore as a food product is traceable to His Highness the late Maharaja of Travancore (1880-1885) whose interest in the development of the economic resources of the State was great. If to-day tapioca is the poor man's food in Travancore it owes that position to His late Highness.

The cultivation of tapioca is easy. The cultivation generally begins with the first showers of the monsoon. The land is lightly ploughed to the depth of a foot or a foot-and-a-half. In some places little mounds of earth are made and the cuttings planted, while in others small platforms are raised sufficient to allow of three or four cuttings being thrust in. The cuttings are generally taken from the previous year's crop and are from nine to twelve inches long, care being taken to utilize for plantation as much of the root portion as possible. After these cuttings are planted, generally in a slanting direction, much attention is not required. The only manure used is a heap of dry leaves and ashes. Water is rarely let in; tapioca depends for its growth on the rains. The cuttings being hardy, they can stand a little of drought in case there is failure of rain. I have known of cases in which tapioca cuttings have withstood the effects of flood for a few days and have been all the better for the silt thus deposited. The number of cuttings planted varies from two to four. After the lapse of about a fortnight, these cuttings take root when small tufts of green leaves appear. These leaves, when they fully grow, resemble the palm of the hand, the arrangement of the leaves from the stem being, what a Botanist would call, palmate. They are five-lobed, seven-lobed, nine-lobed, etc.

At the end of eight or ten months the roots are dug out. After the crop is taken, preparations are commenced for the next year's crop. Tapioca is an exhausting crop, that is to say, it is supposed to take for its growth all the natural fertility of the soil. For this reason a piece of land after it has been under tapioca cultivation for two or three years is left fallow for some years until the lost vitality of the soil is recouped by nature.

The tapioca root is from two to three feet long, three to five inches thick at the thickest portion and weighs from ten pounds in weight. There are considerably bigger fruits with lateral developments which I have seen exhibited at several Agricultural and Industrial Exhibitions. But they are not one-year roots and are allowed to grow under the soil for two and even three years. They are unfit for human consumption, are more woody than farinaceous and are objects more of show than of any use.

Tapioca can be cultivated almost at any elevation below, say, 2,000 feet above the level of the sea. The hill men cultivate a variety which is more tasty and mealy than the one grown in the plains. Once I happened to visit a hilly station in Travancore and wanted to see the hill men in their natural habitat. In their anxious desire to see us comfortable they brought huge tapioca roots dug out in our presence and offered them to us. The roots are so mealy that they easily break into white, soft, milky pieces when boiled. They can be mixed either with grated coconut or sugar and eaten. They are exceedingly nourishing. One point that has to be noted is that these hill tapiocas should be used as early as possible after they are dug out; the later they are used, the worse they become. They are utterly useless two days after they are dug out. The truth is that these hill roots have a peculiar kind of milky juice and when this juice is absorbed or disappears, the root becomes sapless and loses its taste. To hill men this variety of tapioca forms their

all, food and money for other necessaries of life. They bring a good lot of them to the plains, where they easily sell them and take in return salt, tobacco, cloth, etc.

Tapioca root is used as food by the poorer classes in Travancore. The thinner brown skin and thicker white skin inside are peeled off and the root is cut into small slices. The fibre inside the mealy portion is also removed. The slices are then boiled in water and afterwards a small quantity of salt and coconut are mixed with it and then eaten. On an average, a family of four working class people do not require more than two annas worth of tapioca roots and the food is exceptionally nutritious, as the sturdy health of the peasantry in Travancore well shows. Tapioca is also used in other ways. Thus, the roots are cut into small circular pieces and dried in the sun and are stocked for use in times when fresh tapioca will not be available. They are, for purposes of eating, used in the same way as the fresh slices. Cart loads of the dried pieces in gunny bags are sold in markets and are also exported. These return to us in bottles in the shape of flour and are again bought by us at a high price. It is, indeed, a pity that there are no factories in India where the dried tapioca can be converted into flour.

There are two varieties of tapioca, viz., poisonous and non-poisonous. I do not propose to name the fifteen or sixteen varieties of tapioca that I know of and give the characteristics of each. Suffice it to say that even some of the poisonous varieties can be cooked and eaten, provided the root is well boiled in water and the water thrown away many times. The test is this: if, after straining twice or thrice or more even, the root is free from a sweetish taste, it may be considered perfectly harmless.

The value of tapioca as food is very great and is being increasingly appreciated. The price is going up steadily year by year and the root is coming to be recognised as an article of diet among a larger and wider circle of people.—MYSORE ECONOMIC JOURNAL.

GRAM CULTIVATION (*CICER ARIETINUM* L.) IN INDIA.

ALBERT HOWARD, GABRIEL L. C. HOWARD & A. R. KHAN.

This Bulletin* is entirely devoted to the study of the cultivation of gram in India where the area under this plant every year is about 18,000,000 acres. The grain is an important food for man and cattle, while the dried stems and leaves are used as fodder.

The factors affecting the yield are: the nature of the soil; the special conditions of the climate at the flowering season; the time of sowing; and the specific productivity of the different types.

The distribution of gram depends chiefly upon geological and agricultural conditions; this plant requires a light, open, well aerated soil for the normal development of the root system and the formation of nodules. In heavy, argillaceous, moisture retaining soil, gram grows with difficulty, the root-system is very superficial and only a few pods set seed. Thus on the alluvial district of the Ganges gram is only grown on 176,000 acres, as against 175,433 acres in the Province of Agra where the soil is a somewhat sandy,

* In Memoirs of the Department of Agriculture in India, Bot. Ser. vol. vii No. 6.

open, well drained loam passing towards Bengal into an exceedingly fine silt of high moisture retaining capacity. As the soil alters in texture towards Bengal, so the area under gram falls. On such soils, the shallow-rooting, erect and early flowering varieties should be grown, in order that the roots may not encounter, in their growth, increasingly disadvantageous conditions likely to greatly impede their development.

Another factor that has much effect on *Cicer arietinum* is the damp due to wet and cloudy weather which, when it occurs during the flowering season, prevents the setting, as is shown by the following data:

Variety.	Effect of rainy weather on setting.			Effect of fine weather upon setting.		
	No. of flowers.	No. of pods formed.	Percentage set.	No. of flowers.	No. of pods formed.	Percentage set.
Type 23 ...	18	2	11	18	15	83
"Large Kabuli"	18	4	22	18	13	72
Type 22 ...	21	5	25	21	17	81
Type 21 ...	19	1	5	19	12	63
Type 20 ...	20	9	45	20	18	90

The time of flowering is of importance in several ways and should be taken into consideration; in all selection work, preference should be given to the types flowering at the end of the cold weather, when the season begins to change and the days are generally bright and warm, thus promoting pollination. There is then ample time for the seed to set before the hot damp winds begin. Excessive earliness in flowering is associated with low yielding power, while on the other hand, very late flowering is a disadvantage, as a rapidly ascending temperature interferes with the normal development of the grain.

As regards the date of sowing, the best results were obtained at Pusa when the crop has been put in rather late, during the first week in November, by which time the light lands have had time to lose a good deal of their moisture. Late sowing, as has been seen, checks excessive vegetative growth developed at the expense of seed production. The yield finally depends upon the productiveness of each variety. The large seeded varieties have only one seed in each pod. The colour of the seeds varies from white to black through various shades of yellow and red. The lighter the colour of the seeds, the higher their price; thus the colour is a new element serving as a guide in the work of selection.

The white gram, type No. 9, is interesting from its habit, which is very spreading with numerous side branches. This type unites both yield and quality; it has been grown for 4 years at Pusa, and under the most different soil and climatic conditions has always yielded an average of over 20 maunds (1642 lb.) per acre.

The Bulletin finally gives a classification and description of the various types, 25 of which have, so far, been isolated at Pusa, and are distinct in habit, size and colour of flowers, the shape and colour of the different parts of the corolla, as well as in the colour and dimensions of the leaves and seeds.—BULL. INTERNAT. INST. OF AGRIC.

SOILS AND MANURES.

LIMING EXPERIMENTS.

B. BUNTING.

In the publication of an article on the "Acidity of Malayan Soils,"* Mr. M. BARROWCLIFF indicated that it was doubtful whether the application of lime to acid soils would have a beneficial effect until all the acidity had been neutralised, and that it would have merely a neutralising action on the acidic constituents.

As further evidence was required to support the above theory, MR. BARROWCLIFF, in collaboration with the writer, initiated a series of experiments to test its validity on Malayan Soils, the results of which are given in detail below.

THE REDUCTION OF SOIL ACIDITY.

The chief purpose for which lime is applied to agricultural soils is the correction of "soil acidity," which may be due to the presence of purely mineral constituents or to the accumulation of organic residues produced by the decomposition of the organic constituents.

In temperate climates "soil acidity" is frequently the limiting factor in crop production, although some crops are much less sensitive than others.

The soils of this country being derived to a great extent from acid rocks, and the heavy rainfall being responsible for the leaching out of any lime salts present, we have conditions very favourable for the production of acidity, since no bases exist to neutralise the acids formed from the rapidly decaying vegetable matter. Nevertheless, the natural vegetation flourishes luxuriantly under these conditions, which is in striking contrast to the natural vegetation of acid soils in temperate climates and it appeared somewhat doubtful whether many of our tropical crops would be benefitted by neutralisation of the soil, i.e., the total reduction of the acidity. On the other hand a partial neutralisation might result in the production of considerable activity in the decomposition of nitrogenous compounds with a resultant improvement in the crop.

It has frequently been observed that excessive applications of lime to moor soils are injurious; the cause of injury being due to loss of nitrogen produced by the rapid decomposition of nitrogenous compounds and the leaching out of nitrate.

From a number of analyses of Malayan Soils, (*loc. cit.*) MR. BARROWCLIFF found that the "lime requirement" varied from $2\frac{1}{2}$ to 3 tons per acre on undulating land to 5-$6\frac{1}{2}$ tons for clays and peaty clays, whilst one peat soil had an acidity of no less than 14 tons per acre.

In the case of the more acid soils it is quite probable that the total reduction of acidity by a single application of lime would result in the destruction of the equilibrium normally existing between the micro-flora and micro-fauna of the soil.

*AGRICULTURAL BULLETIN, F. M. S. Vol. III. No. 2.

LIMING EXPERIMENTS AT CASTLETON ESTATE.

The object of the experiments was to show the relative effect of 1, 2 and 3 tons of lime on the growth of both leguminous and non-leguminous crops on two areas the soils of which had "lime requirements" of 6·4 and 5·4 tons per acre respectively. The controls were unlimed.

An analysis of the soil on which the experiments were conducted showed it to be exceptionally heavy, containing a large pre-ponderance of clay and fine silt particles and to be well supplied with nitrogen, potash and phosphoric acid.

COVER AND CATCH CROP PLOTS,

The area under experiment was divided into 4 plots, one untreated and the others treated with 1, 2 and 3 tons of quicklime per acre respectively. An untreated strip separated the different plots. Each plot was sub-divided into six sub-plots and the various crops planted transversely across the limed area so that the effect of the different treatment on each and all of the crops could be easily seen.

The lime requirement of the soil on which these experiments were carried out was 6·4 tons per acre.

MR. J. LAMBOURNE, Superintendent, Government Plantations, Telok Anson, who was in charge of the experiments, reports on the different plots as follows :—

Plot 1. Sarawak Bean (Dolichos Hosei).

"This plant was planted from cuttings which were very slow in taking root and growing away. Little difference could be seen between the growth of the plants on the limed and unlimed plots for about three months, when those on the limed plots began to show stronger growth. After four months the plants on the limed plots had spread and made a complete cover, while those on the unlimed plot had spread over the ground but more thinly. The difference in the colour of the foliage on the limed and unlimed plots was very noticeable, the former being of a dark green colour while the latter were yellowish and not so strong."

Plot 2. Canavalia ensiformis.

"The seeds of this crop were sown about 2 feet apart across the different plots. The seedlings came up and grew vigorously on the limed plots, but those on the unlimed plot began to turn yellow and die in patches almost as soon as they appeared above ground. The result was a patchy crop on the unlimed plot and an even plant with strong growth on the limed plots. The plots with two and three tons of lime per acre gave slightly stronger growth than the plot with one ton, but the difference was not very marked."

Plots 3 and 4. Groundnuts (Arachis hypogea).

"These comprised two plots, one being planted on ridges 18 inches apart and 9 inches apart in the rows; the other sown broadcast and harrowed in. The seeds were sown in the early part of May. The percentage germination was good, but the plants on the unlimed plots died off in patches when quite young. Almost from the first a marked difference could be seen between the limed and unlimed plots. The plants grew more evenly and stronger where lime had been applied, whilst the plants on the unlimed plots were thinner and less strong in growth."

The following tables shew the yield of groundnuts obtained under the two systems of planting.

(a) YIELD OF GROUNDNUTS ON RIDGES.

Plot.	Treatment.	Yield of nuts per plot.	Yield of nuts per acre.	Relative yield.	Lime requirement.
		lb.	lb.	lb.	Tons.
3 A	No. lime	1½	25	100	6·4
3 B	1 ton lime	25	417	1668	6·4
3 C	2 ,, lime	32	533	2132	6·4
3 D	3 ,, lime	32	533	2132	6·4

(b) YIELD OF GROUNDNUTS ON LEVEL.

Plot.	Treatment.	Yield of nuts per plot.	Yield of nuts per acre.	Relative yield.	Lime requirement.
		lb.	lb.	lb.	Tons.
4 A	No. lime	1¼	18	100	6·4
4 B	1 ton lime	18	257	1429	6·4
4 C	2 ,, lime	33	471	2619	6·4
4 D	3 ,, lime	35	500	2780	6·4

Plot 5. Centrosema plumieri.

"Seeds of this cover crop were sown broadcast across the plots. The seedlings came up evenly and for about 2½ months little difference could be seen in the growth of the plants on the limed plots compared with that of the unlimed plots. Later the plants on the limed plots began to grow more strongly and quite a good cover was obtained, while the plants on the unlimed plot did not look so healthy and growth was slow. The lime did not have such a marked effect on this plant as it had on the other crops."

Plot 6. Horse Gram (Dolichos biflorus).

"Seeds of this plant were sown at the rate of about 8 lb. per acre. The seedlings came up thickly and grew very well until they obtained their second leaves, when a marked difference between the limed and unlimed plots became apparent. The plants in the unlimed plots began to die off leaving patches of plants which grew well, but not so strongly as the plants on the limed plots, whilst the limed plots grew away evenly and gave a splendid cover, through which it was difficult for weeds to penetrate. This plot was not weeded for five months after the seeds were sown and it was only after the plants commenced to die down that weeds began to appear. A slightly thicker cover was obtained where two or three tons of lime per acre was applied, but the difference was not very marked."

GINGELLY PLOTS.

This area was divided into 4 plots, one untreated and the others treated with 1, 2 and 3 tons of quicklime per acre respectively, similar to the other experiments.

The lime requirement of the soil was 5·4 tons per acre. *Gingelly* (Sesamum Indicum).

"The plots were sown with gingelly about three weeks after the lime was applied. The seeds were sown broadcast at the rate of 5 lb. per acre. The seedlings germinated in a few days and came up very thickly, a marked difference being apparent between the limed and unlimed plots. On the limed plots the seedlings came up evenly and grew away vigorously, while

those on the unlimed plot came up in patches and growth was slow. As the plants grew the difference became more marked, and after the plants flowered and the seed capsules began to set, those on the unlimed plot became diseased while those on the limed plots remained healthy. The whole of the area that was limed irrespective of the quantity applied grew and seeded well, but the plots to which two or three tons of lime had been applied gave better results than the plot with one ton. The plants in these plots were stronger and grew larger than those in the plot with one ton of lime per acre. Very little difference could be seen between the plots with two and three tons of lime per acre."

The following table shows the yield of gingelly seed and the weight of dry matter per plot obtained from the crop taken shortly after the application of the lime.

YIELDS OF GINGELLY (1ST CROP).

Seed sown May 5th, 1915, and harvested August 17th, 1915.

Plot.	Treatment.	Gingelly Seed.			Gingelly Plant.			
		Yield per plot.	Yield per acre.	Relative yield.	Yield per plot.	Yield per acre.	Relative yield.	Lime requirement.
		lb.	lb.	lb.	lb.	lb.	lb.	tons.
1 E.	No. lime.	38	88	100	196	456	100	5·4
2 E.	1 ton lime.	166	386	436	353	821	178	5·4
3 E.	2 ,, lime.	215	500	565	615	1,430	310	5·4
4 E.	3 ,, lime.	216	502	567	771	1,793	389	5·4

In order to test the effect of the initial application of lime on a second crop the plots were re-sown eight months later and gave the following yields:

YIELDS OF GINGELLY (2ND CROP).

Seed sown January 14th, 1916, and harvested April 25th, 1916.

Plot.	Treatment.	Gingelly Seed.			Gingelly Plant.			
		Yield per plot.	Yield per acre.	Relative Yield.	Yield per plot.	Yield per acre.	Relative yield.	Lime requirement.
		lb.	lb.	lb.	lb.	lb.	lb.	tons.
1 E.	No. lime	30	70	100	147	342	100	5·4
2 E.	1 ton lime.	81	188	269	246	572	167	5·4
3 E.	2 ,, lime.	90	209	299	327	760	222	5·4
4 E.	3 ,, lime.	101	235	336	389	904	264	5·4

RESULTS OF THE EXPERIMENTS.

From periodical inspections of the different plots the following observations were made by the writer:—

In every case the plot which received no lime showed much poorer growth than those which were limed, the ground being absolutely bare in patches and the plants not so strong as those on the limed plots. The plots which received 1 ton of lime were completely covered and the crops appeared

to be much healthier in colour than the unlimed plot. The plots which received 2 and 3 tons of lime produced a slightly thicker cover when compared with the 1 ton plot, but there was no marked difference between the 2 and 3 ton plots.

The yield of groundnuts given in Tables I and II show a distinct correlation with the above observations.

Reference to Tables III and IV show the yields of gingelly seed together with the weight of dry matter produced by the plant, and from an inspection of the figures it will be seen that the plots which received 1 ton of lime gave large increases in yield when compared with the unlimed control. The plots which received 2 tons of lime gave a further increase whilst the application of 3 tons of lime produced little or no difference compared with 2 tons, which indicates that crop production was reaching its limit.

INFLUENCE OF LIME ON YIELD OF LATEX.

The writer recently published the results of a series of "Manuring Experiments on Rubber"* and the following table may be of interest in showing the effect of lime on the yield of latex.

The soil on which the experiments were carried out consisted of a fairly rich loam of a peaty nature overlying an alluvial clay sub-soil.

YIELD OF RUBBER FOR 11 MONTHS.

Plot.	Treatment.	Yield per 100 trees per annum.	Relative Yield.	Lime requirement.
		lb.		tons.
8 A	No lime.	204·9	100	6
6 A	1 ton lime.	252·1	123	6
8 B	No lime.	192·4	100	4
6 B	1 ton lime.	242·1	126	4

As will be seen from the above table, although the soils showed an acidity of 4 and 6 tons the application of only 1 ton of lime had a marked influence on the yield of latex.

CONCLUSIONS.

The experiments show that a decided improvement in crop production can be obtained by the application of lime in quantities not sufficient to neutralise entirely the acidity of the soil, and that such improvement is not directly proportional to the reduction of acidity.

In determining what quantity of lime it is most profitable to apply, the results indicate that an application of one ton of burnt lime (Calcium oxide), say every 4 years, will give the best return. If on some soils heavier applications are considered necessary it is recommended that the interval between the applications be reduced, rather than increasing the quantity of lime at a single application.

The above conclusions are based on the growth of a limited number of crops on one particular type of soil, but further experiments are being arranged on different types of soils, the results of which will be published later.—AGRIC. BULL. F.M.S.

*AGRICULTURAL BULLETIN, F.M.S. Vol. IV. No. 5.

PESTS AND DISEASES.

THE CONTROL OF THE SOUTH-AMERICAN HEVEA LEAF DISEASE.

DR. G. STAHEL.

The investigation of this disease is now completed. The bulletin, however, cannot be published before January or February 1917, as the drawings and photographs which illustrate the disease must be reproduced in Holland. It seems therefore advisable to publish a preliminary note now on the method of control.

The disease is caused by a fungus which has three different fructifications.

The chief fructification, the perithecium, is found only on old leaves, at the earliest, one to two months after they are full grown.

The pycnidial fructification frequently appears on recently expanded leaves. After two months, the perithecia predominate and it is often only then possible to find perithecia on the leaf.

The Scolecotrichum form fructifies almost exclusively on young leaves.

The Scolecotrichum conidia germinate in water after about two hours. If they are sown on a young leaf, we find after ten hours a great percentage of the germ tubes under the cuticle, and after about twenty hours they have penetrated between the epidermal cells and have spread beneath the latter. If the conidia are allowed to dry, they die after fifteen hours.

The pycnospores germinate in water or in a nutrient solution after a few hours, but the germ tube is at most two to three microns long. If sown on the young leaves, the germ tubes do not develop further. The pycnospores are therefore not of importance in spreading the disease.

The ascospores germinate in about the same time as the Scolecotrichum conidia. When sown on young leaves, solitary short germ tubes are found under the cuticle after twelve hours, and after twenty to twenty-two hours these germ tubes, which are much thinner than those of the Scolecotrichum, have grown further under the cuticle, but have not yet penetrated between the epidermal cells into the leaf. If the spores are dried, they die in a few hours. The production of ascospores is small, even when the leaves bear many perithecia; I could obtain ascospores for my experiments from only a few trees. Moreover, the leaf tissue round the perithecium dies, and, therefore, on many trees, the perithecia also die in a short time.

The ascospores therefore contribute little to the spreading of the disease.

The full-grown leaves, which almost alone bear pycnidia and perithecia, are consequently only dangerous to a slight degree. On the other hand, it is quite the contrary with the young, not yet fully developed, leaves. The latter produce great numbers of Scolecotrichum conidia which under favourable conditions generally infect healthy young leaves.

We find here in the Hevea plantations, during the whole year, trees which winter or trees which produce young shoots, in consequence of which

sufficient young leaf with the Scolecotrichum fructification is present at all times.

From the above facts we can now deduce the following conclusion.

If we secure that for three or four weeks the plantation is kept free of all young Hevea leaves, then the Scolecotrichum fructification disappears, and as the conidia die within twenty-four hours.

The Scolecotrichum fructification will subsequently re-appear and spread, since the ascospores are not entirely innocuous. The operation must therefore be repeated from time to time, but it remains to be determined how long an interval will suffice.

For this method of control, it is necessary that neighbouring plantations carry out this operation at the same time, or that he who will not treat the disease shall remove Hevea from his fields.

Since the leaves in Hevea, some eight to sixteen, stand close together at the end of the small branches, and these can generally be cut off with a sharp cacao knife at the end of a long stick, such an operation can certainly be carried out. If, for instance, during the dry season, when the flow of latex is small, the labourers are distributed over the Hevea fields for single weeks, they will be able to destroy all young leaves, since at a given time only a small number of trees are wintering or producing new shoots. A labourer will be able to treat, in one day, two large, or more small, trees.

Whether this method of control is possible in Surinam from a financial standpoint or whether it is not better to substitute Erythrina for Hevea in those diseased fields which are interplanted with coffee, is a question into which I shall not further enter here.

I have until recently greatly overestimated the importance of the ascospores in spreading the disease. The researches of the last two months have shown that the infective capacity of the ascospores can be insignificant, and on this result, I can advise a method which as it happens is not only well-founded, but is also actually technically feasible.

A week ago it was stated in one of the local papers that planters in Surinam were scarcely acquainted with the treatment of the disease whilst it had been done successfully in Demerara. That compels me to say something here about the method advocated.

The Mycologist of Demerara, MR. C. K. BANCROFT, recommended that the young leaves should be sprayed with Bordeaux mixture, the dead branches should be cut off up to the sound wood, and the fallen leaves should be collected and burnt.

The last is unnecessary, since the parasite dies when the leaf dies. Dead fungi do no more damage. Cutting off the dead branches as far as the sound wood is, from my researches, even less to be recommended. I have therefore on some plantations where that was done persuaded the planter not to procced with it. The reasons will be given in the Bulletin.

Spraying the trees with Bordeaux mixture will, if it is done when the leaves are two to four days old, have a favourable influence, but the application in practice appears to me for various reasons more difficult, more expensive, and not so decisive as the method I have described. Moreover, experiments here have shown that the young leaves, one to three centimetres long, cannot stand spraying with Bordeaux mixture but curl up and fall off. That happened in spraying experiments in the Slootwijk plantation.—MEDED. No. 6, DEPT.. LANDBOUW, SURINAM.

SWEET POTATO SCURF.

L. L. HARTER.

The sweet potato scurf disease is characterised by a brown discolouration of the surface of the underground parts of the sweet potato. The discoloured areas may occur as spots of varying size with no definite outline, or as a uniform rusting of the entire surface.

Although the infection is very superficial and produces no rupture of the epidermis, scurfy potatoes do not command as high a price in the markets as do clean ones. The fungus, under favourable conditions such as a relatively high humidity and temperature, continues to develop under storage, and besides rendering the potatoes unfit for sale, makes them at the same time less resistant to the attacks of other parasites.

Scurf is more prevalent in heavy, black soils and in soils that have been heavily manured or contain a large amount of organic matter, than in light sandy soils. The writer found the scurf very prevalent on sweet potatoes in New Jersey, Delaware, Maryland, Virginia, North Carolina, Ohio, Illinois, Iowa and Kansas, and to a slight extent in other States. The following varieties are susceptible to scurf in varying degrees: Eclipse Sugar Yam, General Grant Vineless, Florida, Nancy Hall, Yellow Yam, Miles Yam, Red Brazilian, Dahomey Yellow Strasburg, Pierson, Key West Yam, Vineless Yam, Southern Queen, Big Stem Jersey, Yellow Jersey, and Early Carolina.

The scurf disease of the sweet potato was first recognised in 1890 by Halsted, who named the fungus "*Monilochaetes infuscans*," a new genus and species. He failed, however, to describe either the genus or species. The writer has isolated the organism and shown by inoculation experiments that it is the true cause of the disease. After a detailed description, he points out that although the organism on the host consisted merely of sporophores and conidia, in culture well-defined branched mycelia and spores developed.

—Bull. Internat. Inst. of Agric.

ULTRA-MICROSCOPIC PARASITES ON PLANTS.

There appears to be no longer room for any doubt that organisms exist of such minuteness as to be invisible to the highest powers of the microscope; nor that among these denizens of this unseen world, some, at all events, are agents of disease. Evidence that certain diseases of animals may be brought about by such infra-microscopic microbes has existed for some years, but it is only recently [? nearly 20 years.—Ed. T. A.] that it has been forthcoming in the case of diseases of plants.

The first case to be thoroughly investigated is that of mosaic disease of Tobacco, but it is probable that the agency of ultra-microscopic organisms will be proven also in other plant diseases, as for example, mosaic disease of Tomatoes and leaf-roll of Potatoes. The extraordinary difficulty of disinfecting a house in which mosaic disease of Tomatoes has declared itself is well known to commercial growers. This alone might lead us to suspect that one of the ultra-microscopics is the agent of that disease, a suspicion confirmed

by the discovery that it is possible to produce the symptoms of the disease by inoculating Tomatoes with the virus of diseased Tobacco plants.

The existence of such ultra-microscopic organisms opens up new and difficult problems to the plant pathologist, for it may be taken as an axiom that the smaller the organism the more difficult it is to kill. This is certainly and wonderfully the case with the mosaic disease of Tobacco. The "virus" of this disease is so resistant that it is not killed by ordinary doses of poison. Chloroform, ether, toluene leave it unscathed; formalin in less strengths than 1 in 800 fails to destroy it; and it passes easily through an ordinary filter.

Hence not a few investigators have held that the infective principle—a trace of which may set up disease throughout the whole of a plant—is not a living thing, but some potent but dead poison. But the only thing we know that is capable of growing and reproducing itself is the living organism. The recognition of this is at the base of the biologist's definition of life, so that it is more logical to invoke the existence of ultra-microscopic organisms than to believe in dead poisons which are able to increase themselves to an unlimited extent. One point of practical importance is worth noting in connection with the virus of mosaic disease of Tobacco, and that is that it is destroyed, by moist heat, at a temperature of about the boiling point of water. Hence it should not prove impossible to rid greenhouse soil of such infinitely minute pests, though how they are to be got rid of from the open ground remains a problem which the future must solve.—GARDENERS' CHRONICLE.

BROWN BLIGHT OF TEA *(COLLETOTRICHUM CAMELLIÆ)* IN INDIA.

W. MACRAE AND R. D. ANSTEAD.

Colletotrichum Camelliæ has recently become prevalent on Tea plantations in the neighbourhood of the Nilgiri-Wynaand and Wynaand districts and it has caused more damage than usual, causing defoliation and weakening the whole plant. The fungus has also been noted in two instances on nurseries, where it does a considerable amount of damage.

Brown blight has been reported from Assam, Darjeeling, and Ceylon and also from Tea growing districts in other parts of the world. In all the districts of southern India visited by the writers, this disease is present. The following recommendations for the control of the disease are suggested.

(1) In nurseries: As soon as the disease appears, all attacked leaves should be picked off and burned and the plants then sprayed with Bordeaux Mixture. The plants should then be watched, and on any signs of the disease reappearing, a second spraying should be given. All dead and dying plants as well as fallen leaves on the ground should be removed and burned. Slaked lime should be sprinkled on the ground surface of the beds and lightly worked in. The nurseries should be kept as open to light and air and as dry as is consistent with the wellbeing of the plants. Watering should be very carefully done and only when absolutely necessary, in order to avoid too moist conditions and a damp atmosphere favourable to the growth of the fungus. The surroundings of the nursery should be freed from weeds and jungle and kept as open to the sunlight as possible.

(2) In old Tea: When the old Tea is not badly attacked, it is best not to do anything until pruning time. Where the Tea is attacked all prunings should be burned and all fallen and dead leaves should, as far as possible, be collected and burned. Slaked lime should be broadcasted at the rate of 5 cwt. per acre and forked in so as to bury any refuse that may be left and to clean up the fields. Manures which tend to produce a rapid growth of sappy wood and abundance of leaves, such as nitrates, nitrolim, etc., should be avoided on areas liable to the attack of the fungus. Nitrogen, if needed, should be supplied in the form of organic manures such as Cattle manure, Poonac, Fish, etc., or better still green dressings such as Dadap. Manures which tend to produce hard wood should be used, such as Phosphates and Potash, and mixtures of Basic Slag, or Basic Superphosphate, or Ephos phosphates, with Sulphate of Potash. Wood Ashes might replace the potash for the present.—BULL. INTERNAT. INST. OF AGRIC.

LOCUST DISEASE IN THE PHILIPPINES.

M. A. BARBER AND C. R. JONES.

In view of the reported successful use of *Coccobacillus acridiorum* d'Herelle, in the destruction of locusts in Argentina, this method was tested in the Philippines. The culture was received in May 1913, and its virulence was increased by the inoculation of a series of locusts, subsequent lots being inoculated with material taken from dead or dying locusts of the preceding series. In the first series, carried to the 30th set of insects, fæces were expressed from the abdomen and diluted with broth as the directions recommended. It was soon found that the insects did not show the required symptom, i.e., liquid excrement. In the second series, bacilli were taken entirely from the body-cavity; in the third, the inoculation material consisted of fluid pressed with aseptic precautions from the leg of a dead or dying insect. As controls, material was taken from the body contents of 10 healthy locusts obtained from the field and was spread on agar in test-tubes. Nine tests showed no growth, while one exhibited three colonies, possibly contaminants. The controls remained in good condition for days with but little diminished numbers. In addition, controls were made of insects inoculated with *Bacillus prodigiosus*. The death of the insects followed with about the same regularity and after as short an interval as when the *Coccobacillus* was used. Another control series was started with inoculations of the gut contents of an insect which died at a station some distance from the laboratory. Insects died as quickly after intra-abdominal doses of this material as after doses of *Coccobacillus*.

FIELD EXPERIMENTS.

Field experiments were alike negative with both strains. Inoculation with the accelerated strain caused death somewhat sooner than that with the stock culture. The insects in the field were mostly wingless and varied from nymphs just emerged from the egg to those in the 5th instar. The infective material was sprayed early in the day on grass or other food among and in front of the advancing swarm. The experiments extended over a period of more than 20 days and through one wet period, although for the most part the weather was hot and dry. Later experiments in which the cultures were mixed with rice polishings and syrup gave similar results. One experiment conducted in an open rice field during a relatively wet period gave partially positive results. The spray used was broth in which were crushed a number

of insects found dead in a corral experiment. In no case was there any indication of a natural spread of the infection in the swarm, and cultures from dead insects found in the field and emulsions of body contents of these insects failed to give positive results in subsequent spraying. The species concerned, viz., *Œdaleus nigrofasciatus*, De Geer, and *Locusta migratoroides*, R. and F., as well as the prevailing high temperature, may have caused these negative results. According to D'HERELLE, the lack of success could be attributed to a lack of strength of the virus. In the case of *Dociostaurus* (*Stauronotus*) *maroccanus*, 56 passages were required before a sufficiently strong strain was obtained. Judging from the time necessary for the bacterium to kill the inoculated insect, the virulence was quite sufficient. Experiments were continued on a new culture of *C. acridiorum* obtained from Argentina. The culture was submitted to 23 passages. In no case was there the least evidence of the spread of infection in the field.—REVIEW OF APPLIED ENTOMOLOGY.

GROUNDNUT LEAFSPOT.

A. F. WOLF.

Researches have been conducted in Alabama in order to determine : (1) the efficacy of rotation and seed treatment in the control of leafspot, *Cercospora personata* (B. and C.) Ellis, which causes spots on the leaves of *Arachis hypogea ;* (2) the correlation between the destructiveness of the disease and the presence of certain climatic conditions ; (3) the agencies concerned in the distribution of leafspot.

The following results were obtained :—

(1) Rotation by itself is not effective under field conditions in eliminating leafspot, as shown by a field in which groundnuts had not been grown for 11 years and in which 95 per cent. of the plants were diseased by August 31, with an estimated loss in yield of 19·5 per cent ; the germs of the fungus continue to develop and spread in the soil even in the absence of the host plant, so that seed disinfection with copper sulphate or formaldehyde before planting does not prevent leafspot. Neither does shelling groundnuts before planting to eliminate the danger of infection from conidia, prevent the disease; (2) An approximation of the total leafspot area involved by *Cercospora personata* showed that the photosynthetic area had been decreased 35·07 per cent. Estimation of decrease in yield of peas of from 5 to 20 per cent. as the result of leafspot are therefore regarded as reasonable ; (3) No correlation between the presence of certain conditions of temperature and moisture and the prevalence of leafspot exists ; (4) the wind largely contributes to the dispersion of the fungus ; as the result of 210 glycerin exposure-plate tests made in different parts of Alabama, it is concluded that *Cercospora personata* is wind-borne. Seventy-eight of these 210 exposure plates gave positive results. At no time from August 9 to August 26 was there a period of maximum spore dispersal as revealed by the exposure plates ; (5) Many insects are disseminators of the leafspot fungus, either by carrying conidia on the surface of their bodies or by voiding conidia in their fæces, the vitality of the fungus being in no way diminished ; of 75 insects belonging to the orders *Orthoptera*, *Lepidoptera*, *Coleoptera*, and *Hemiptera*, collected in 5 different localities, 54 gave positive results.—BULL. INTERNAT. INST. OF AGRICULTURE.

DRUGS AND SPICES.

SENNA.

Senna leaves ranked twelfth among the exports from the Madras Presidency to the United States in the first six months of the current year, aggregating 319,349 pounds (2,851·33 cwt.) in quantity and $46,307 in value. In the calendar year 1915 the declared exports totalled 452,192 pounds (4,037·43 cwt.) valued at $42,512. The exportation of this drug is restricted in order that a good percentage of the supply may remain in the country.

The plant is of the bean family (*Cassia angustifolia*), and the product as exported consists of dried leaflets. The drug enters largely into medicinal prescriptions.

The present species of senna (Tinnevelly), as also the Alexandrian (*C. acutifolia* Delile), were introduced to both Indian and European pharmacy through the Arabs. The former species (the only one grown in India) is fairly extensively produced in Tinnevelly, and recently its cultivation has been extended to Madura and Trichinopoly, districts of South India, and to Poona in Bombay. It is sown on red or black clay loams, fairly liberally ploughed and manured, the sowing being in May. Weeding has to be attended to, but irrigation is hardly, if ever, necessary. The season for collecting the leaves is June to December. The yield is said to be 1,000 pounds (two candies) an acre, which allows a handsome margin for profit.

Indian senna is either exported coastwise to Bombay and thence to foreign countries, or is consigned direct from Tuticorin. The drug is also imported by India from Arabia, where it is collected from the wild plant and accordingly often much adulterated. It would appear that about 5,000 cwt, are usually taken by India and re-exported under the name of East Indian senna or Moka or Aden senna. For many years past, however, the imports from Arabia have been declining and the exports of Tinnevelly senna improving.

The purity, high quality, and low prices of the Indian article place it in the front rank. In 1887-88 the total exports from India of locally grown senna came to 21,376 cwt. valued Rs. 318,869 ($103,451). More recent figures are given by some writers, such as 5,000 candies annually from Tuticorin, but the data for an exact and detailed statement of the total trade are not available. Quite recently a new form of senna has appeared in the London markets from India. This has been shown by BARBER to be *C. montana*, but as a drug it has been found inferior to *C. angustifolia*.

Later (official) figures covering the exports of domestic senna from British India ports during fiscal years ending March 31st, show a sharp falling off in the war year 1914-15, when shipments aggregated only 6,663 cwt.; but this loss was more than made up in the fiscal year 1915-16, when 34,280 cwt. were exported.—OIL PAINT AND DRUG REPORTER.

IMPORTS OF SPICES.

The CHAMBER OF COMMERCE JOURNAL states that the imports of cinnamon to the United Kingdom in 1914 and 1915 were:

From	1914. lb.	1914. £	1915. lb.	1915. £
Seychelles ...	181,660	1,463	327,792	2,168
Ceylon ...	684,367	15,420	2,937,444	79,858
Other British ...	115,696	1,659	166,984	4,282
Foreign Countries ...	70,938	1,256	7,770	394
Total ...	1,052,661	19,798	3,439,990	86,702

Cinnamon is mainly used as a spice, and also in medicine and in the manufacture of incense. A fair quantity of the bark imported by Germany, Holland, and the United Kingdom is used for distilling purposes. The English distilled oils are especially esteemed.

The exports of cinnamon from Ceylon in 1915 were 6,494,124 lb., as compared with 3,988,752 lb., an increase of 2,505,372 lb. The quantities of cinnamon exported during 1915 must be considered quite satisfactory, taking into account the difficulties as regards prohibition of export and scarcity of freight. The exports of cinnamon oil from Ceylon in 1914 were 10,129 oz., value £390, and of cinnamon leaf oil 36,936 oz., value £228.

PEPPER.

The imports of pepper to the United Kingdom in 1914 and 1915 were as follows :—

From	1914. lb.	1914. £	1915. lb.	1915. £
Straits Settlements ...	10,938,293	370,796	13,918,644	463,491
India	2,011,831	44,730	8,768,905	203,803
Ceylon	221,562	5,808	143,725	3,483
Other British ...	499,065	8,760	719 528	23,669
Total British...	13,670,751	430,094	23,550,802	694,446
French Indo China ...	688,764	14,511	766,080	18,605
Java	4,751,826	130,627	5,803,045	170,135
Siam	1,786,614	61,249	627,956	24,521
Other Foreign ...	1,849,989	50,187	2,248,136	58,524
Total Foreign	9,077,193	256,574	9,445,217	271,785
Total ...	22,747,944	686,668	32,996,019	966,231

VANILLA.

Vanilla is used chiefly as a flavouring for chocolate, confectionery, and liqueurs. The exports of vanilla from Seychelles in 1914 amounted in value to £8,782. The planting of vanilla has been given up by small planters in many localities and replaced by the cultivation of bananas, which are less profitable but a more regular crop. The owners of large estates, on the other hand, have taken up vanilla cultivation on a larger scale since the

succession of wetter seasons, and nearly all the previous plantations, which had been destroyed by seven years of drought, have been replanted.

The exports of vanilla from Ceylon in 1914 were 13 cwt., value £693.

The cultivation of vanilla has continued to attract attention in Dominica and Nevis; once the difficulty of curing is overcome there appears to be opening for the cultivation of this product in favourable situations.

NUTMEGS.

The main use of nutmegs is as a spice. Oil of nutmeg is used for scenting soap. The exports of nutmegs from Grenada in 1914 were 12,656 cwt., value £21,165, as compared with 14,557 cwt., value £25,205 in 1913, and of other kinds of spices, principally mace, the exports were 2,157 cwt., value £15,727, as against 2,479 cwt., value £19,062, in 1913. The cultivation of spices in Grenada is confined almost entirely to nutmegs, with its derivative mace. The area devoted to the cultivation is not increasing, and has remained stationary for years, owing to the decline in prices. Mace has of late years commanded a relatively favourable price, and has had the effect of making nutmegs a profitable crop. It is worthy of remark that, although the area devoted to the cultivation has not been extended, the output of the island has steadily increased during the past ten years, and has just doubled during the decade. This is due to the fact that the crop of a nutmeg tree tends to increase with its age.—GROCERS' JOURNAL.

PRODUCTION OF NUX VOMICA IN MADRAS.

Among the products exported from the Madras district to the United States in the first half of the current year nux vomica ranked seventh, following skins, coconut oil, pepper, coir yarn, indigo and sandalwood, and amounted to 2,666,118 pounds, valued at $134,097. In the calendar year 1915 they totalled 1,470,180 pounds valued at $52,489.

Nux vomica is shipped in the form either of seeds or of "pickings," the latter being husks or shells washed from the seeds. The product is of commercial value as being the source of the alkaloids strychnine and brucine, With the exception of Ceylon, which exports a limited amount of nux vomica. British India is said to supply the world. In addition to the alkaloids just mentioned the seeds yield a dye, which produces light brown shades on cotton cloth, and an oil employed medicinally by native practitioners in India.

PRODUCING CENTRES—CHARACTERISTICS OF SEEDS.

The snakewood, nux vomica or strychnine tree (*Strychnos nux-vomica* Linn) grows wild in the forests and is also cultivated to a limited extent in gardens in India. It is a moderate-sized deciduous tree of the Gorakhpur

forests in Southern India, Bengal, Orissa, the Deccan and Karnatak, moist forests in the Bombay Presidency, and deciduous forests all over India. The producing centres in the Madras Presidency are Tanjore, Trichinopoly, Pudukotah, Calicut, Rajahmundry and Nellore. Shipments go mainly to London and New York. Formerly Hamburg was an important mart. The average yearly production throughout India is estimated at 40,000 cwt. Production is under the control of the Forest Department of the Government of India. The seed is included in the general items of minor forest produce, and the right to collect is usually sold to the highest bidder.

Nux vomica seeds and pickings are obtained from the plumlike fruits of the trees. The fruit is collected and the seeds washed out and dried in the sun, or the seeds are simply gathered from the ground, but in the latter case they have little commercial value. They are roundish, flat, or concavo-convex in shape and silvery in colour. The best seeds are known in the trade as fine, bold, and fresh. Their appearance should be "bright," that is, clean and silvery. Each nut contains about a half dozen seeds.

HANDLING THE OUTPUT—PRICES.

In the forests of Nellore, where the tree is common, the seeds are washed out by a forest tribe, the Yanadis, and a good price is obtained for them. Cochin nux vomica is collected in the dry, deciduous forests at the foot of the Travancore hills and is sold at a low figure to small native dealers, who send it to the merchants. The nux vomica of the eastern coast finds an outlet at Cocanada and shipments bear the name of Cocanada nux vomica. The Madras seeds come from Nellore and several other parts of the Presidency. Madras, Bombay and Cochin are the ports in India from which nux vomica is chiefly exported.

The current quotation for nux vomica in Madras at the end of June was 1 anna 3 pies ($0.025) per pound. Nux vomica is packed in robbins or bags usually of 164 pounds when exported, the shipping ton being 14 to 16 cwt. net.—OIL PAINT AND DRUG REPORTER.

CHEMICAL AND DRUG MARKETS.

The chemical and drug markets remain much as previously reported, with little of interest to report. Menthol has commanded more interest in view of the crop shortage, and higher prices have been paid. Shellac is also dearer both on spot and for delivery. A sharp advance is noted in linseed oil, and to a less extent in coconut, crude cotton-seed, palm, rape, and soya oils. Otto of rose and sandal-wood oil are higher, and sweet-birch oil firmer. Lemon oil is arriving freely against contract. Among alkaloids and fine chemicals atropine is lower. Salicylates to arrive are easier, likewise sulphonal, salol, citric acid, and hydroquinone. Peppers are dearer and cloves easier.—CHEMIST AND DRUGGIST.

AGRICULTURAL EDUCATION

FURTHER ARGUMENT FOR AGRICULTURAL COLLEGES.

In Volume I. of the Transactions of the Third International Congress of Tropical Agriculture, held at the Imperial Institute during June, 1914, will be found the papers that were read on the subject of agricultural education. Taken as a whole it cannot be said that these communications lead us very much farther ahead, particularly in connection with the much-discussed question of tropical agricultural colleges. That these institutions are needed appears to have been generally recognized at the Congress, but no suggestions were made as to carrying the idea into effect. The outbreak of war, a month later, naturally had the effect of causing a complete cessation of public interest in the matter, but during the past two years, the extraordinary revelations which the war has produced in regard to showing the national importance of science, has tended to revive public interest in the matter, and there is every possibility that this will increase in the future.

The relative importance to Great Britain of her tropical possessions would appear to become greater and greater the longer the war continues, and in this fact would appear to lie one of the strongest arguments for the immediate provision of better educational and research facilities. In the case of cotton, we observe a very ominous development of the spinning industry in the United States and the increasing home consumption of the raw material produced in that country. It would appear—and the matter has been openly admitted by the British Cotton Growing Association—that Lancashire's supply of cotton will have to depend more and more upon production within the Empire, and this will mean a very large extension of the cotton growing areas. In order to compete with the home consumption of raw cotton in the United States, this British-grown cotton will have to be produced cheaply especially in view of the further handicap of heavy freight charges.

Another kind of raw material which constitutes an important tie between Great Britain and the tropics is rubber. The amount of British capital invested in rubber plantations is very great indeed, and no matter whether this rubber is shipped to British or American manufacturers it is of the greatest importance to maintain high dividends by reducing the cost of production and by the prevention of undue depreciation on the estates.

In regard to sugar, also, there are signs that the economic connection between Great Britain and the tropics will be strengthened. Political action will probably be taken to secure a larger supply of British-grown sugar than in the past; but the most satisfactory way and probably the only way of increasing the amount of British-grown sugar will be by reducing to the lowest possible point the cost of production so as to enable the British colonies to compete with foreign rivals—both beet and cane—if necessary in the open market.

In the case of all three of these raw materials future progress appears to depend upon efficient production. Efficient production means the application of science in its widest and most practical sense—in improving soil fertility, in fighting diseases of plants, animals and man, in training labour, in introducing improved implements and machinery, in breeding better plants, in improving transport facilities, and in being methodical and economical in every direction.

To carry this into effect requires an elaborate educational organization. It is not sufficient to educate one class of worker connected with a great industry and neglect another. Labour needs instruction in manual operations and in co-operative action; the estate manager needs training in the principles and practices of crop production, in labour management and business matters, and requires further to possess a good general knowledge of the sciences underlying the art he practises; even the capitalist whose money is invested in tropical agriculture requires a sound theoretical knowledge of matters relating to the crop in which he is interested in order that he may see the wisdom of adjusting expenditure in order to achieve maximum efficiency. A fourth class to be provided for is comprised of the scientific expert who works in an advisory capacity with the actual producers and is generally maintained by the State. Further provision must be made for training the research worker whose ultimate duty is to investigate more or less abstract problems of science without regard to their immediate practical importance. On the work of the research student, the expert is largely fed and through him fresh information filters down to the estate manager until it eventually finds its application in estate practice.

The scientific workers require specialized courses of academic study in contra-distinction to the general course of technical study needed by the planter himself, or the specialised manual and moral training required by the labourer.

To provide these systems of education in the tropics it is necessary to have agricultural colleges, or at least some definite extension of the educational side of the present Government Agricultural Departments in the more advanced colonies. Considering the great diversity exhibited in tropical agriculture even in the cultivation of one and the same crop, all the functions of a college as outlined above could not be fulfilled by a single institution to serve the tropics as a whole. It would probably be found that several colleges situated in different places and affiliated to a central institution in Great Britain would answer best. The work of each in a sense would probably tend to become specialized in so far as it would have regard to one staple crop more than another. Thus one can conceive of an agricultural college in the West Indies becoming renowned as a centre for the study of sugar production, of another in the Federated Malay States for the study of rubber; just as in England one agricultural college is noted for its natural facilities for teaching stock farming and another for instruction in cereal production.

There can be no doubt that the establishment of such institutions of education and research in the tropics would quickly have an educational influence of a far-reaching kind, and soon have the effect of strengthening the trade relations between the tropics and the Mother Country.—THE AGRIC. NEWS.

CO-OPERATION.

PROGRESS OF CO-OPERATIVE SOCIETIES IN THE BARODA STATE IN 1914-15.

The report of the Registrar of Baroda State for 1914-15 furnishes a record of good work done during the year under review.

The following table gives the increased number of societies, the number of members, and the working capital:—

Kind of Societies.	No. of Societies.		No. of Members.		Working Capital.	
	1913-14.	1914-15.	1913-14.	1914-15.	1913-14.	1914-15.
					Rs.	Rs.
Central ...	3	2	176	220	128,170	184,062
Agricultural ...	246	286	6,918	8,071	452,006	536,439
Non-Agricultural ...	13	18	655	976	59,660	79,719
Total ...	262	307	7,749	9,267	639,836	800,280

Writing of the increase of societies the Registrar says that "except in a few places no special efforts were made to organise new societies. In most of the cases the people came forward of their accord. They are generally attracted by the successful working of a society in the neighbourhood."

The Reserve Fund of all the societies amount to Rs. 69,584·00 as against Rs. 44,500·00 in the previous year. The amount of loans given during the year was Rs. 586,566·00, an increase of Rs. 73,358·00. Nearly one-third of the loans have been granted for the ordinary agricultural operations such as the purchase of seeds or manures, the payment of labourers' wages, etc. Among other purposes we find the following:—For purchasing cattle and implements, for paying Land Revenue and repaying old debt, trade, industrial work, and for household purposes.

Among the non-credit societies there is a Milk Supply Society which supplies milk to a depot in the town, a Milk Consumers' Society which distributes the milk from the depot to the residents in the town and a non-credit Agricultural Society which supplies water for irrigation purposes.

There are 18 non-agricultural societies of which 5 are Government Servants' Credit Societies, 11 are Weavers' Societies, one is Municipal Scavengers' Society and another is of the same type.

Under the heading of publications the Registrar remarks that "if the co-operative movement is to be developed, well-organised efforts should be made to educate farmers in the principles of co-operation. A handbook on co-operation for use in rural Primary Schools has been prepared."

The Registrar has received official and non-official help in the development of the movement. As a result of a "special resolution passed by the Honourable Council asking the officers of the Revenue Department to help the movement I am glad to observe" says the Registrar "that most of the officers of that department have always been of great-help to us in our work."

N. W.

GENERAL.

THE COLONIZATION OF CANAL LANDS IN THE PUNJAB.

The South-Western Punjab is part of a vast desert which may be said to extend from the Sahara to Manchuria.

Prior to 1849, when the British annexed this part of the Punjab, the area supported a sparse nomadic population.

Colonization of these desert wastes was not seriously thought of till 1885 when a policy of canal irrigation was undertaken.

Five great perennial canals were taken in hand. They collectively irrigate a wheat area rather more than twice the size of Ceylon.

One particular canal completed in 1892 commands an area of $3\frac{1}{3}$ million acres. Three-fourths of this area was State property. This canal irrigates now something over $2\frac{1}{2}$ million acres yearly. The capital expenditure on this work was over 300 lacs of rupees; the interest it now earns is on an average about 28 per cent.

Another canal completed about 1911 irrigates an area of about $\frac{3}{4}$ million acres and the interest earned exceeds 10 per cent.

Before 1892 the population of the Lyallpur district could not have been more than 2,000. In 1912 the number had increased to over 850,000.

To settle so large an agricultural population was no easy matter. The problem needed wise statesmanship, a very intimate knowledge of the peasant farmer and his ideas, enthusiasm and a kindly sympathy.

That these are of more importance than the principles on which projects and schemes were based should be emphasised. Thus SIR JAMES DOUIE writes:—"The Colonies have been admirable training ground for the ablest of the younger Punjab officers. It was necessary to give them a pretty free hand, the work was novel and important, and involved great responsibilities. While he was controlled from outside, the Colony Officer inside his Colony had to be a benevolent autocrat. Autocracy is tolerable when the autocrat is content to be also the servant of his people, and in this respect the Punjab officers did not show themselves lacking."

It must not be thought that no mistakes were made. The problems were novel and at times very difficult. Nor must it be thought that there were no setbacks. Plague invaded the province in 1897 and broke out virulently in the canal districts in 1904 and 1907. Outbreaks of cholera were also frequent. In 1905 crops were injured by frost and almost the whole crop of cotton had been destroyed by the boll-worm.

The settlement scheme has now passed the experimental stage and stands out as one of the most notable achievements of British Administration in India.

SIR JAMES LYALL'S name will always be associated with this work. He gave his conception of a scheme of colonization thus:—"An attempt should be made to establish estates owned by bodies of peasant proprietors." [The Punjab is chiefly a country of small holdings.—H. L. VAN B.]

"In the Eastern part of the Punjab and in the sub-Himalayan tracts there not infrequently are found villages peopled by agriculturists of the best type, who have increased in numbers until the lands which they own are insufficient for their support; often the owners of such estates have been accustomed to cultivate as tenants in neighbouring villages. But, owing to the owners of those villages now requiring the lands for themselves (they) are gradually being ejected.....It would improve the general condition..... if some of the proprietors would emigrate to other countries.....A number of men of this class might be induced to settle in the Gujranwala Bar by being allowed to migrate in bodies.....formed by themselves, and by the promise on certain conditions of grants of land.....The experiment might be tried in the following way.....Go to places in the thickly populated districts, where groups of adjacent villages are owned by men of the same clan, and.....search among them for men of some amount of enterprise, capital, and influence, and ask such men.....to lead down bodies of men of their own clan to the Government lands irrigated by the canal. Well selected blocks would be made over to the bodies so migrating. The leader of the colony would be given an interest in its success not only by receiving a share in the proprietorship but also by his being made headman of the new estate."

SIR JAMES LYALL thought it "essential to preserve the tradition of the Punjab as a country of peasant farmers." He, however, made three kinds of grants. "Yeoman grants" were to attract a class above the ordinary peasantry—the middle class. "Capitalist" holdings were granted so as to supply "natural leaders for the new society." It is interesting to note that yeoman and capitalist grants are now given up. Land grants for meritorious service to native officials are condemned after the experience gained. Grants are occasionally given, however, to members of the hereditary landed gentry. The peasant farmer's settlements were most successful and gradually out of these settlers are arising leaders and captains of industry.

The system of allocating land to peasants that is now approved is to give each a rectangle consisting of 25 acres. On fulfilling the conditions of the lease a permanent right of occupancy can be acquired after five years.

This can be converted into ownership by paying the market value as deduced from auction sales less a percentage that is fixed.

The purchase money may be paid in instalments which may extend over 30 years. Till this is paid the settler remains a tenant paying Re. 1 per acre in addition to water rates, land revenue and cesses.

In the pioneering attempts to colonise the land, after five years, on fulfilling the terms of the lease, the settler acquired ownership by paying a sum of only Rs. 3 per acre. The modifications brought in subsequently were due to the fact that there was eager competition for the land, the pioneering difficulties having been overcome.

Before the land was leased out contour maps of the irrigable lands were made and the areas served by separate water-courses were defined. Village areas were made to coincide with water-course areas. Each village was sub-divided into square fields or rectangles. These formed the units for allotment. It has been found necessary later that a soil survey should also precede allotment. Good land, mediocre land and land too poor to cultivate should be discriminated. Otherwise water-courses would uselessly be carried into land not worth irrigating and raise up many difficulties.

The selection of peasant settlers, their location on the land and their future welfare is not by any means the least part of the scheme. It really sums up the scheme in its entirety and it is to such work as previously emphasised that the success to a very great extent of this colonization is due.

HENRY L. VAN BUUREN.

INDIAN FIBRES.

The fibres of India may be roughly classified in three groups: (1) Textile fibres, such as cotton, flax, silk, jute, and jute substitutes; (2) cordage fibres, such as Sunn hemp, Manila hemp and plantain fibre, and Sisal, Mauritius and bowstring hemps; and (3) fibres suitable for other purposes, including upholstery work, the manufacture of explosives, and paper-making. Work on Indian fibres of all these groups has been carried out at the Imperial Institute, but in the time at my disposal it is only possible to mention a few typical examples of such investigations.

As an example of the first group, viz., textile fibres, reference may be made to a fibre which appeared on the London market about fifteen or sixteen years ago under the name of Bimlipatam jute, the origin of which was not then known. Analysis and a comparative examination of commercial Bimlipatam jute with the various Hibiscus fibres contained in the Indian Collections of the Imperial Institute proved that the fibre was the produce of *H. cannabinus*. Consequent on this discovery, considerable attention has been devoted to the plant in India during recent years, and improved races have been established.

Another fibre of the jute class, *Sida rhombifolia*, on examination at the Imperial Institute, was found to be of such high quality that it was recommended that its cultivation should be encouraged. A good deal of work has now been carried out by the Department of Agriculture in Bengal, and it has been found that the value of the fibre is about 10 to 20 per cent. in advance of "first marks" Calcutta jute, but that the plant gives a smaller yield per acre and the fibre is more troublesome to prepare than jute owing to the interior of the stem being soft instead of hard and woody. These difficulties deserve further attention.

The second group, viz., cordage fibres, may be illustrated by reference to the fibre known as Sunn hemp, which is obtained from the stem of *Crotalaria juncea*. Samples of this fibre from Burma, Calcutta, and the Pabna district of Eastern Bengal have been examined at the Imperial Institute. All the samples were of good quality, those from the Pabna district being the best. This fibre finds a ready sale in the United Kingdom at good prices, and it was pointed out in the report that the cultivation of the crop could be safely extended. The annual exports of Sunn hemp from India during the years 1909–1914 amounted to about 30,000 tons, of which about one-half was consigned to the United Kingdom. Since the outbreak of war the demand for Sunn hemp in this country has greatly increased owing to the difficulty of obtaining Russian hemp, the imports in 1915 being about 28,000 tons as compared with 15,000 tons in 1914.

The third group, viz., miscellaneous fibres, may be illustrated by the products consisting of the seed-hairs of various plants and known as flosses or silk-cottons. Those of the following Indian plants have been examined at the Imperial Institute and information supplied as to their value and uses: *Eriodendron anfractuosum* (the true kapok tree), *Cochlospermum Gossypium*, *Calotropis gigantea*, and *C. procera*. There is an export trade in such materials from India, but it is probable that the source of most of the exported floss is *Bombax malabaricum*.

The use of these flosses has assumed increased importance during recent years. Formerly they were almost exclusively employed as stuffing materials for upholstery, but owing to their buoyancy and impermeability to moisture they are now being used extensively in the manufacture of life-saving jackets and similar appliances. Considerable demand has arisen for flosses for such purposes, and good prices are being realised.—IMP. INST. BULL,

CASSIA AURICULATA (Linn,)

***RANAWARA* S. *AVARAI* T.**

A very well-known shrub occurring gregariously in the low-country in dry districts near the coast. TRIMEN describes it as "a great ornament to the barren coast regions." The plant has many wide-spreading branches and smooth-brown bark with abruptly primate leaves (each consisting of 12 pairs of leaflets), closely arranged, and with large ear-shaped stipules. The flowers are large and yellow, very conspicuous, generally crowded at the end of branches. The pods are rather papery and thin.

The leaves cured and dried is well-known as "Ranawara Tea" or "Matara Tea." MR. DRIEBERG (T. A., April, 1907, p. 230), has reviewed the investigations of the Imperial Institute on the dried leaves which do not contain caffeine.

The leaves are used medicinally as a blood purifier, in the case of diabetes and also as a laxative.

The plant is known popularly as "The Tanner's Cassia" and the object of this note is to direct attention to its bark which should prove to be a profitable source of tannin if the plant is systematically cultivated. WATT reviewing modern researches and opinions comes to the conclusion that this Cassia must be assigned a much lower position than it was reputed to hold in Southern India as a tanning material.

It would appear that the greatest drawback is that samples show extreme variations in their tannin content probably due chiefly to the fact that the bark is collected indiscriminately from plants of all ages. This results in a very unsatisfactory tannage and leather prepared with this bark alone has been reported to change into a murky brown. Evidence, however, is not lacking that with bark selected from mature plants a very satisfactory tannage can be obtained.

Its utility is particularly evident when blended with other tanning materials. When blended with myrabs (fruits of *Terminalia* spp.) it gives on the whole a mellow tannage with leather of a light colour and which cuts very well. Its use is recommended for heavy and for dressing leathers though it must be condemned for fancy leather goods and bookbinding.

Its value in a blend is chiefly for colour where myrabs give gloss and *Acacia* bark give substance to the leather.

A point worth noting of cassia bark is that the maximum amount of tannin is extracted at higher temperatures at almost the boiling point of water. MEHD has shown that 22% of tannin is extracted at temperatures of 85°–90°C when only 15·5% is capable of extraction with water at 30°–40°C (Year Book, 1912. Ind. Guild of Sc. & Techn. p. 137.)

With regard to cultivating the plant it must be noted that whilst it can grow on barren and waste land, it flourishes best in deep soils. Its cultivation should present no difficulties, young plantations will only require weeding. One of the large tan factories at Cawnpur has cultivated it to a small extent; under irrigation (the rainfall being under 40 in.) it yields in the 2nd and 3rd year and in the 4th and 5th year if not irrigated.

Its cultivation close by to a tan factory should prove remunerative in Ceylon.

HENRY L. VAN BUUREN.

AGRICULTURE IN INDIA.

JAMES MACKENNA.

[The following is an abstract of a pamphlet by MR. JAMES MACKENNA, recently published, which gives a full account of the work accomplished by the Indian Department of Agriculture since its inception.]

I.—HISTORICAL.

The annual value of the agricultural produce of British India has recently been estimated at roughly £1,000,000,000. More than 2/3 of the inhabitants are engaged in agriculture or in the industries subsidiary to it. In spite of the importance of agriculture to the national economy of India, there was no Department of Agriculture formed until 1880. In 1878, the terrible famines decided the British Government to send a Commission to India to study the best measures to be taken for the improvement of agricultural conditions. On the advice of the Famine Commissioners, there was formed, in 1880, a Department of Agriculture under the guidance of SIR EDWARD BUCK, (now Delegate of India at the International Institute of Agriculture, Rome). In the first place, it was necessary to: (1) organise the survey: (2) compile statistics of production: (3) institute enquiries as to the local agricultural conditions in the different districts of India. The data thus obtained and supplemented by the isolated and interrupted work of some scientific workers appointed by one or other of the Provinces, or working on their own initiative with the view of assisting some special branch of agriculture, laid a solid foundation for the systematic studies and researches afterwards undertaken by the Staff of the Agricultural Department. In 1901, an Inspector-General of Agriculture was appointed, and a staff of scientific workers recruited. For the latter, there were provided at Pusa, in the district of Bihar, an agricultural research institute, an experimental farm, and an agricultural college. No regular course of instruction is given at the Institute, but the graduate who has completed his general agricultural education can specialise in one branch under the personal supervision of an expert. In the financial statement of 1905-1906, it was announced that the Imperial budget would allot the sum of 20 lakhs (subsequently raised to 24 lakhs) to the improvement of agriculture. Colleges were accordingly reorganised, or started, at Poona, Cawnpore, Sabour, Nagpur, Lyallpur and Coimbatore. To these Agricultural Colleges were attached provincial Research Stations and Experimental Farms. At the present time, 29 agriculturists, 9 agricultural chemists, 8 economic botanists, 3 agricultural engineers, 1 entomologist and 1 mycologist are employed at these provincial establishments.

II.—ORGANISATION AND WORK OF PROVINCIAL DEPARTMENTS OF AGRICULTURE.

In each of the 9 provinces, agricultural and veterinary work is under the control of a Director of Agriculture. In the provinces where there are agricultural colleges, the scientific officers are stationed at the College, and have their laboratories, herbaria, etc, there. Attached to the college, is a farm used for training students in practical agriculture, and where the improvement and selection of cultivated plants, manurial experiments etc., are carried out. The results obtained are brought before the notice of the native agriculturists by the Demonstration Farms. Finally, at the seed Farms, the improved seed is grown for distribution to the native farmers.

Deputy Directors, aided by a staff of Indian Assistants, control the experimental, demonstration and seed farms. This method of working has already greatly improved many of the chief crops grown in India.

III.—CROPS.

(1) *Cotton.*—The area under cotton has increased more than 67 per cent. in the course of the last 20 years, and at the present time, represents over 6 per cent. of the total cultivated area of India proper. The cotton crop of 1913-1914 was estimated at over 5 million bales. Of this crop, nearly 3 million bales, worth more than 27 million pounds sterling, were exported. In Madras, during the last 20 years, the area under cotton has increased by a million acres; in Bombay, by nearly 1·5 million acres; in the Punjab, by 900,000 acres; in the Central Provinces and Behar, by over 1·5 million acres, while the native states show an increase of nearly 1·5 million acres. In Bombay, the United Provinces and the Central Provinces, attempts have been made from the earliest days, but with little success, to introduce foreign varieties of cotton. Subsequently, the indigenous cottons of India were surveyed by the Imperial Cotton specialist, and aided by the data obtained, the provincial officers proceeded to isolate and maintain pure types, to improve quality by selection, and introduce the improved plant into general cultivation. By this means, varieties with higher yields and larger lint percentage were obtained in the Presidencies of Bombay and Madras, in the Central Provinces, and the United Provinces. At the same time, an attempt was made to introduce exotic varieties, especially into districts where they had not been cultivated before; thus Egyptian and Upland American cottons have been introduced into Sind; American varieties have been established in Bombay, the Punjab and the United Provinces, and one type of "Upland Georgian" in the Central Provinces, but the greatest achievement has been the introduction of "Cambodia" into the Presidency of Madras. Experiments in the improvement of agricultural practice, in cultivation, crop rotation and on manures are being carried out on experimental farms, and the results, when proved, are being introduced into general practice.

(2) *Wheat.*—About 10 per cent. of the total cultivated area of India is under wheat, and about 15 per cent. of the total area of cultivation in the native States. In the last 5 years there has been an all round increase of about $8\frac{3}{4}$ million acres, while in 1915, there was a further increase of 6 million acres. As it was found that all the varieties of wheat grown in India were peculiarly liable to rust, many attempts were made to introduce Australian, English and North American wheats, but without success, because these varieties mature too late, and the growing season of wheat is relatively short in India.

Lately, MR. and MRS. HOWARD, have selected at Pusa, 25 types of Punjab wheats which are distinguished for their high yield. They are now trying to obtain, from these types by selection, and by crossing with foreign varieties, wheats with standing power, rust resistance and high gluten content (the latter being required by the British market). Satisfactory results have already been obtained and as it has also been found that these varieties of wheat do well in other parts of India, it has been proposed to increase the amount sown on a large number of the Punjab seed farms, in order to distribute the selected seed throughout the wheat growing districts of the country.

(3) *Rice.*—This cereal is predominant in the Eastern Provinces and Burma. The area under rice exceeds 80 million acres, which represents 35 per cent. of the total cultivated area of India. In Assam, nearly 80 per cent. of the cultivated area is under rice, in Burma, 74 per cent. and in Bengal, 70 per cent. The varieties of paddy are numerous, and this makes selection and the improvement of methods of cultivation a very difficult task. Nevertheless, the efforts already made have been successful from the points of view of yield and nutritive value. At the present time, the work of selection is chiefly based on the shape, colour, uniformity and consistency of the grain. The work is being carried out upon irrigated and non-irrigated rice varieties;

spacing and manurial experiments are also being conducted in all provinces. The general experience seem to be in favour of green manuring for transplanted paddy; bonemeal is, however, in many provinces, reported to give good results. Other experiments have been made as to the dates of ploughing and sowing, the amount of seed to be used, and the number of young plants to be planted out. The control of insect pests and fungus disease has also been begun, but it is rendered difficult by the vast size of the tracts affected.

(4) *Sugar-cane.*—As a result of foreign competition, there has been a considerable diminution of the area under this crop during the last 25 years, notably in Bengal, Bombay and the Central Provinces, but as a set-off, there have been large increases in Madras, the United Provinces and Assam. The total area under sugar-cane in 1913-14 was 2,519,800 acres, of which the United Provinces contributed 1,379,910 acres and the Punjab 411,200. In Southern India, varieties with thick, fine canes and high sugar yield are grown, which do not do well in Northern India. In Southern India, cultivation is much more intensive heavy dressings of manure being given, but though the quality is good, the crop is unimportant and the area under sugar-cane is very small. A parasitic disease, known as "red rot," does great injury every year to the sugar plantations. It is therefore necessary to obtain by selection and crossing, richer canes giving higher yields, possessing greater resistance to disease, and yet adapted to the methods of the native cultivator. Such is the work on which DR. BARBER has been engaged at his own research station at Coimbatore; the Experimental Farms of the United Provinces, Bihar and Assam have also been occupied with the same problem, and considerable results have already been obtained in this direction. Further, much has already been done in improving the sugar-making machines, and in devising a machine that will be suitable for sugar-making on a small scale by small cultivators, or groups of cultivators.

(5) *Jute.*—India is the only country which produces this plant on any scale, and its cultivation is limited practically to Bengal and Assam. The area under jute has averaged, in recent years, about 3 million acres. During the last 10 years, the number of jute mills in Calcutta has increased from 38 to 66. Extensive trials have shown that the successful cultivation of jute is quite possible over a wide area outside the jute-growing districts and that in Burma, Assam and North Bihar, the area is capable of a large extension. The selection of some of the cultivated types, which has been carried out since 1906, the year in which FINLOW began his study of the jute cultivated in India, has furnished some pure lines possessing high yielding power, strength and durability. Some of these pure lines have been grown and seed is now available for distribution. It is hoped that it will be possible to improve these varieties still further by the help of hybridisation. Manurial experiments at Burdwan and elsewhere have shown that in addition to cowdung, oil-cake and green manures (*Vigna Catjang*) can be profitably applied.

(6) *Other fibrous plants.*—Flax, Sunn hemp and *Hibiscus cannabinus* (Bombay hemp) occupy about 800,000 acres. These plants have also been improved by selection. Some entomological and mycological enquiries regarding the Coconut palm, which is cultivated on the West Coast of Madras and in the maritime tracts of Lower Burma, have resulted in much practical advantage.

(7) *Indigo.*—Twenty years ago, the area under indigo was well over a million and a quarter acres; it is now only 131,700 acres and steadily decreases. With a view to rehabilitating the industry, the Java indigo plant was introduced in 1898, but in 1907 it was attacked by some unknown disease which killed the plant before the seed set, so that for some time it was impossible to improve the qualities of the plant by selection and

crossing. MR. HOWARD, however, discovered later that it was not a question of a disease properly so-called, but that the wilting of the plants was due to long-continued wetness of the soil, and to the bad cultural methods employed by the natives, who always remove all the leaves from the plant at once. Proper aeration of the soil is essential, and a full supply of air to the roots, and especially to the nodules of the roots, is necessary for the production of a crop of good indigo plants.

As selection based upon *indican* content is too difficult and delicate a process ; those plants which grow more rapidly and robustly and carry more leaves than the bulk of the crop, are grown apart, in order to obtain a type producing a high *indican* content. To improve the cultivation, it is recommended to harrow back after the removal of the cover crop, to prune instead of cutting back, and to remove the crop after the second cut. By these methods, it is hoped that it may be possible to restore indigo cultivation to its former flourishing condition.

(8) *Tobacco.*—Several promising varieties have been isolated, and it still remains to fix their qualities by hybridisation; the methods of cultivation have also been improved.

(9) *Oleaginous Plants.*—A certain amount of selective work has already been done on rape and sesame; the latter crop covers something like a million acres in Burma. The ground nut was introduced into India in 1902, and has expanded with much rapidity, now being regularly grown in the arid zone of the country and in the United Provinces.

(10) *Tea.*—This plant was introduced into India about 1836. The industry has, generally speaking, prospered from that date, while between 1886 and 1910 the area under tea only increased by 98 per cent., the production in the same period increased by 266 per cent ; this was due to the scientific workers employed by the Indian Tea Association and the United Planters' Association of Southern India.

(11) *Coffee.*—Coffee growing dates from the beginning of the 19th century; the industry is practically confined to the Madras Presidency. Mysore, Coorge, the Wynaad, the Nilgiri, Pulney and Shevaroy Hills. It does not enjoy the same prosperity as tea, for it encounters very severe competition from Brazilian coffee.

(12) *Rubber Plants.*—Rubber is a crop which is coming into prominence, especially in Burma and Madras. The exports in 1913-1914 were valued at over half a million sterling.

(13) *Fruit-growing.*—This industry has not been neglected, and much has been done especially at Quetta and Peshawar, to improve the varieties cultivated, and to introduce better methods of fruit packing and transport.

IV.—SILK.

The silk industry is comparatively insignificant, and tends to decrease on account of the competition of other countries, especially Japan. Nevertheless, an attempt has been made to increase the production by the introduction of better methods of rearing the silkworms, and the improvement of the loom used in silk manufacture.

V.—IRRIGATION AND DRAINAGE.

Considerable progress has been made of late in these directions, especially in Madras, Bombay, the United Provinces, and the Punjab.

VI.—SCIENTIFIC RESEARCH.

Much work has been done in the various branches of Agricultural science, especially at the Central Research Station at Pusa, but also at the Provincial Stations.

(1) *Chemistry:* The use of phosphatic manures on Indian soils; the properties of alkaline soils; the water requirements of some Indian crops; the formation and movement of nitrates in the soil; the chemical composition of sugar-cane, sugar-beet, milk, date-palm sugar, the composition and nutritive value of Soy beans, rice, etc., etc.

(2) *Mycology:* Preliminary survey of the important fungus diseases of Indian crops; methods of controlling plant diseases.

(3) *Entomology:* Collection and study of the habits and life-histories of Indian insects. Methods of controlling the insect pests of plants and animals.

(4) *Agricultural Bacteriology:* Bacterial activity in the soil (the soil conditions affecting the supply and utilisation of combined nitrogen; the production in, and elimination from the soil of plant toxins); the study of bacterial plant diseases; the action of bacteria in milk.

VII.—AGRICULTURAL EDUCATION.

Agriculture, as such, is no longer taught in the primary and secondary schools, for it is now agreed that rural education must be general, and that it is necessary to develop the pupils' powers of observation; this, however, does not prevent the use of text-books dealing with familiar objects connected with agriculture.

In the secondary schools, great importance is attached to knowledge of English, to nature study, and practical instruction in the rudiments of chemistry and botany, in order to enable the pupils to profit by the courses at the Agricultural Colleges. The Government of India no longer insists upon a "standard" curriculum in the latter, but leaves the Province free to frame its own scheme of agricultural education with reference to the stage of general educational development and agricultural research that may have been reached. Lately, a native agricultural school has been started in Bombay. This school takes boys from 14 to 16, the course is thoroughly practical and lasts 2 years, while general education is continued, together with special instruction in agriculture.

VIII.—VETERINARY MATTERS AND CATTLE.

The Civil Veterinary Department in India was constituted in 1889; it consisted principally of the military veterinary officers of the horse-breeding establishment. Since 1901 the Staff has been recruited from veterinary colleges in England. The provincial organisation consists of superintendents, who are members of the Civil Veterinary Department; deputy superintendents; inspectors, and veterinary assistants. There are now 909 assistants, 95 inspectors and 19 deputy superintendents. There are veterinary colleges at Bombay, Lahore, Calcutta and Madras, and a veterinary school at Rangoon. The teaching is of a thoroughly practical type and the results are very gratifying. Continuous research work is concentrated at the Imperial Bacteriological Laboratory at Muktesar and a branch laboratory has been opened at Bareilly. The chief work consists in preparing vaccines and sera, especially anti-rinderpest serum.

Cattle-breeding.—In accordance with the views expressed at the last meeting of the Board of Agriculture, the production of "a dual purpose animal" (one combining draught and milk) should be aimed at by crossing native cattle with the best European breeds. In many provinces co-operative cattle insurance societies have lately been started.

MR. MACKENNA'S report deals with the ten years period 1905-1915. In the last chapter, he refers those persons who are desirous of obtaining more complete and detailed information regarding agriculture in the Indian Empire, to the publications of the Imperial Department. These can be obtained from MESSRS. THACKER, SPINK and Co., Calcutta, and are entitled

AGRICULTURAL JOURNAL OF INDIA; PROCEEDINGS OF THE BOARD OF AGRICULTURE IN INDIA; REPORT AND MEMOIRS OF THE AGRICULTURAL RESEARCH INSTITUTE, PUSA.

MR. MACKENNA estimates that the increase in the value of the agricultural products of India, as a result of the labours of its Agricultural Department is already over £2,300,000. The last decade has also seen the rapid growth of the co-operative credit movement—that great factor in all schemes of economic development.

The writer concludes his report by reminding his readers that the motto of the Department of Agriculture should be: "Sympathy and Co-operation."

—BULL. INTERNAT. INST. OF AGRIC.

FIRST GROUNDNUT FORECAST, INDIA 1916-17.

This forecast is based upon reports received from the three provinces of Madras, Bombay, and Burma, which comprises 99 per cent. of the entire groundnut area of British India.

The total area sown in the present season in these provinces is estimated at 2,109,000 acres, as against 1,742,000 acres estimated at this time last year, or an increase of 21 per cent. The season has on the whole been favourable. The details for the provinces are given below:—

FIRST FORECAST, OCTOBER.

Provinces.	1916-17.	1915-16	Increase + or Decrease.—
	Acres	Acres	Acres
Madras ...	1,663,000	1,278,000	+385,000
Bombay (including Native States) ...	201,000	197,000	+4,000
Burma ...	245,000	267,000	—22,000
Total ...	2,109,000	1,742,000	—367,000

The Provincial reports are summarised below:—

Madras (72·1 per cent. of the total area under groundnut in British India) —The total area sown is estimated at 1,663,000 acres, which is 30 per cent. above the area reported at this time last year. The increase is marked in the Deccan and the Central districts. The groundnut crop is replacing cotton to some extent in the black cotton soils, and is steadily spreading in the red soils. The extension of cultivation has been stimulated by the steadily rising prices that ruled during the past year. The season so far has been favourable to the crop.

Bombay (15·1 per cent. of the total area under groundnut in British India).—The total area under the crop is estimated at 201,000 acres (55,000 acres being in the Native States), as against 197,000 acres reported at this time last year, or an increase of 2 per cent. South Deccan districts show some decline in area, due partly to insufficiency of rain at sowing time and partly to rotation of crops; but this decline has been made good by extended cultivation in other districts. The season since sowing has generally been favourable, and the crop is everywhere in thriving condition.

Burma (11·7 per cent. of the total area under groundnut in British India). —The total area sown is estimated at 245,000 acres, which is 8 per cent. short of the area reported at this time last year. The Pakokku and Sagaing

districts continue to show an expansion of area under this crop; Meiktila also shows a small increase. The Myingyan district, on the other hand, shows a very large contraction, and Magwe also returns a reduced area. The district reports indicate that the prospects of the crop are good and that a normal outturn may generally be expected.—DEPARTMENT OF STATISTICS, INDIA.

THE OIL OF THE GROUNDNUT.

In a recent publication issued by the Egyptian Ministry of Agriculture, the Director-General deals very fully with the subject of groundnuts. The following information in regard to the commercial uses of groundnut oil is of particular interest, since this side of the subject is not usually discussed at any length in an agricultural treatment of this crop:—

The freshness of the nuts used in oil extraction is indicated by the colour of the oil which results. After keeping the nuts for some time, a colouring matter, which is present in the nut, diffuses itself into the oil cells and renders the oil dark in colour instead of pale straw colour. M. FLEURY, in a work on the subject referred to by M. ADAMS, says that by long exposure to sunlight the oil bleaches completely. Some varieties of groundnuts give an oil of deeper colour than others; those from La Plata, Congo, and Mozambique are said to be the palest; those from Spain and Senegal slightly darker; while those from Gambia and Sierra Leone, as well as from India, yield the darkest coloured oil. No comparisons seem to be recorded in this matter with regard to Egyptian groundnut oil.

M. FLEURY mentions that on exposure to the air for some months the oil absorbs a certain amount of oxygen, and becomes slightly resinous. This absorption is accelerated by the addition of heat.

Groundnut oil contains a little more margarine than olive oil, yet the fluidity of both is the same. It begins to form a quantity of margarine at 88; at 6° it congeals completely, and at 30° it becomes a solid mass which does not acquire greater consistency. The oils from some varieties congeal more rapidly than others.

As a lubricant, groundnut oil is slightly inferior to olive oil, but as a luminant it is said to be superior.

Groundnut oil of the first expression is often a strong competitor with olive oil as food, and is frequently used for mixing with the latter oil. The most important use, however, is for the manufacture of oleomargarine butter, into which enters about 50 per cent. of milk combined with from 20 to 30 per cent. of oil from Cayor Rufisque (Senegal) nuts, which possess the special flavour required.

The soaps made from groundnut oil are excellent, and are largely employed in washing silk and wool. The oil of the third expression is that which is used in the manufacture of soap; those of the two cold expressions being used almost entirely as comestibles. A small quantity of oil is said to have been used for soap making in Egypt at the factory of Arbib, near Zagazig, but this has recently ceased to work (*vide* MR. CARTWRIGHT).

The cake is employed both as a cattle food and as a fertilizer, but the cleaned and decorticated cake is only used for the first-named purpose. Groundnuts from Southern India are, by reason of their dark colour, less in demand than those from other localities, for which reason they are not skinned before expressing their oil, and the rough cake which is produced from them is employed as manure. The analysis made by M. FLEURY, from cake resulting from Rufisque nuts showed about 8 per cent. of nitrogen, and about 1½ per cent. of phosphoric acid. As a manure, the cake is considered as of great value.—AGRICULTURAL NEWS.

CULTIVATION OF ZIZYPHUS JUJUBA IN MYSORE.

H. THIMMAKRISHNA RAO.

The taluk of Rayadrug which is adjoining Molakalmuru taluk of the Mysore Province in the Chitaldrug district is famous for a few varieties of this *Zizyphus jujuba*. While the small round fruits are common even in Mysore the long or oval fruit variety common in Rayadrug is not generally known. I had met one tree of the said variety in Chintamani taluk where an old Fakir had planted it near a mosque and the fruits of this variety were presented by him to gentlemen as a rarity. In Rayadrug town there are especially two trees one called *Rajumanu* in the neglected tope of the old Palayagar of Rayadrug, and another tree known by the name of *Kedimivallamanu* in the garden of Kedimi people. *Rajumanu* has not grown to be a very big tree and has got only two or three branches while the circumference of the space occupied by the tree is not more than ten or twelve yards, while the *Kedimivallamanu* has grown to be a very big tree and occupies a circumference of about thirty yards. While the first tree yields about 150 to 200 seers of fruit every year the *Kedimivallamanu* yields about 600 to 1,000 seers of fruit. While the *Rajumanu* fruit is sold at about half a rupee a seer the *Kedimivallamanu* fruit is not sold at less than four seers a rupee. So even one tree of the above kind would be a fortune to a poor villager. As the plant is very easily cultivated and does not require any watering after a few years, as it yields a bumper crop, and as the fruit is praised by the orthodox Hindus and Mahomedans the introduction of the superior varieties of it on a large scale in the rural parts of Mysore as part of village industry seems to me to require special encouragement.

Firminger in his Manual of Gardening after describing the plant as a thorny tree that blossoms in the rains and ripens its fruits at the beginning of the cold season, especially in December and January, says that the tree yields in unbounded profusion and it affords a very nice dish cooked with sugar even to the European taste. He says that "this tree is of extraordinary growth, and cut down to the ground after fruiting it will spring up again to the height of fifteen feet and will be covered with an amazing crop of fruit in the following season. It is propagated from seed and requires no care bestowed on its cultivation." It does not generally thrive in cold places or in high altitudes. Though it may not be successful in the areas where coffee is grown I have no doubt that they will thrive very well in the other districts of Mysore. The plant which is a very thorny one, extending laterally rather than growing very high loves to thrive in moist ground while all the varieties of it are very hardy and long-lived The plant seems to grow very well by the sides of nallas, water-courses and irrigation channels, large and small. It seems to love the dry ground, having irrigated ground at some distance. But the seeds do not seem to produce the exact parent plant as in the case of all trees propagated from seeds for various scientific reasons. The stone that is contained in the fruit and the insects that are present in some varieties sometimes dissuade expert gardeners from taking into hand this plant as worthy of their attention. But under scientific cultivation both the above defects may be reduced to a minimum. So the

experts have even recommended the propagation of the best varieties by the process of budding and inarching as recommended by MR. WOODROW in his BOOK ON GARDENING.

MR. WOODROW says that this tree has not been cultivated as much as it deserves. It is said that MOHAMMAD included it among the joys of Paradise. Like other fruit trees generally raised from seeds, there is great variety in size, shape and flavour of the fruit. The best are elliptical, two inches in length by one inch in thickness. This fruit may be grown to perfection in districts with scanty rainfall and is benefited by pruning away the small branches after the fruit is gathered in January. "To raise this tree sow common seeds in any deep friable stony soil and when two years of age bud with the superior variety as low as practicable so as to reduce the danger of suckers rising. Budding is performed exactly as in roses and the month of November has proved a suitable season, but no doubt, the bark will rise freely at any time between May and December. If plants are wanted to send away, seeds should be sown in pots, and when of sufficient size inarched to the good variety. As the seedling takes two years to attain a fair size, this is a more tedious operation than budding." MR. WOODROW from whom I quote this passage, may probably be able to supply plants propagated under his method.

The small elliptical variety of Rayadrug thrive in some parts of Mysore. I would suggest that expert gardeners should send for the seeds of both *Rajumanu* and *Kedimimanu* of Rayadrug, raise plants in various places and try if trees equal to the parent plant could be raised. The *Rajumanu* plant fruits are singular in having no insects in them, the fruits improve by keeping and do not rot away. They can be dried and used as dates. The fruits of both the above plants are also famous for the medicinal qualities. Many believe that the fruits cure asthma, consumption and dyspepsia. So the variety has got many excellent qualities and has got excellent taste almost equalling the taste of a ripe apple and therefore has various claims for being taken into hand for further cultivation and encouragement.

Varieties from Poona, Benares and Calcutta yield elliptical fruits from two to two and a half inches but the taste is rather insipid and cannot compare with that of the Rayadrug variety I have referred to above. Some of the Poona varieties have been cultivated in Kurncol but the fruits contain insects which take away from their value.—MYSORE ECONOMIC JOURNAL.

PLANT BREEDING IN CUBA.

F. S. EARLE AND P. WILSON.

Plant breeding in Cuba was begun in 1901, the year in which one of the writers was called to the island to organise the Government Agricultural Experiment Station at Santiago de las Vegas.

Naturally enough, the most important cultures were the first to receive attention. The testing of seedling sugar-canes has been carried on for the past ten or twelve years at the Harvard Experiment Station, at Soledad, near Cienfuegos. As the soils of the Soledad district do not give satisfactory results with chemical fertilisers, and stable manure is out of the question, the problem to be solved was the production of a sugar-cane giving a good yield even in exhausted soil. A satisfactory solution has been attained. In addition to the production of seedling canes which will maintain a profitable yield on poor soils, an effort has been made to obtain by means of selection, strains which will be resistant to root rot, a disease supposed to be caused by *Marasmius sacchari*. On virgin timber lands in Cuba, canes will often

continue to give profitable results for twenty or twenty-five years without replanting; after this the plants die out, and must be replanted every third or fourth year. The cane usually begins to die at certain spots in the field where the growth is weakest and the disease spreads in concentric circles. Always, however, occasional stools survive in these diseased areas: an attempt has been made to obtain from these, by selection, some immune strains of the "Cristalina" cane, which is so satisfactory in Cuba from most other points of view. Unfortunately, the work was dropped before any results were obtained, but the question is one that promises to yield most valuable results.

Cuba offers a large field of work for the selection of tropical fruits. At present, there is no vine suited to hot climates, though some south European varieties are occasionally grown in Cuba with some degree of success and there is a native species, *Vitis caribæa* which, even in a wild state, produces juicy fine grapes about $\frac{3}{8}$ inch in diameter, dark purple in colour, and might through hybridisation with some of the cultivated grapes give rise to a race which would be of the greatest value to tropical regions. Further, from its productiveness and vigour (this vine sometimes covers trees 18 or 20 ft. high) it would form an excellent stock for grafting.

In the mountains of Cuba, there is a walnut tree, *Juglans insularis*, producing nuts which compare favourably in size with the northern black walnut. The kernels are, however, difficult to remove from the shell and the partitions are thick. Through selection, this tree might be considerably improved and might be also of great value as a stock on which to graft cultivated walnuts (for there are very few nuts that succeed in the tropics). The Queensland Nut, *Macadamia ternifolia*, which has been introduced at Santiago de las Vegas has succeeded very well.

In all parts of Cuba, the mango is one of the most abundant of fruits. There are two distinct races, *mango* and *manga*. The former is a tall, erect tree sometimes 60 ft. high; its fruit is beaked at the apex and the fibre surrounding the seed is long and coarse. The *manga* is a low spreading tree, 35 or 40 ft. high, with more abundant but finer fibre. Two principal types of the *manga* race are distinguished and these are called, from the colour of the flesh of the fruit, the *manga amarilla* (yellow) and the *manga blanca* (white). There are also other races and types of mangoes, the *Filipino*, with very little fibre and of excellent flavour; the Chino and *manga mamey* of Cienfuegos and the *Biscochueto* of Santiago de Cuba; the three last are very limited in distribution, but very superior in quality. The most important work in mango improvement yet done in Cuba consists in the selection and propagation of some of these superior types. The mango seed reproduces the type perfectly.

In order to improve the *avocado (Persea gratissima)*, budded stocks of selected varieties have been imported to Cuba from Florida. In Cuba, a few selections have been made, but the work is only just beginning. The most important point in the selection of varieties is lateness of ripening; and throughout the island are found occasional seedling trees which hold their fruit all the winter.

For the improvement of the *anon* (*Anona squamosa*) the writers advise crossing *Anona cherimolia* with *A. squamosa* and *A. muricata*.

In Cuba, citrous fruits were formerly grown almost exclusively from seed. The Government Experiment Station at Santiago de las Vegas began the work of searching out and propagating desirable seedlings which are found growing half wild in neglected gardens and hedgerows.

Many of the most important tropical vegetables grown in Cuba (*Dioscorea Batatas, D. saliva, D. aculeata. Colocasia* and *Manihot utilissima*) are propagated asexually; the opportunity for selection is not lacking, however, since bud variation is much more common in the tropics than in temperate regions.

DR. JUAN T. ROIG has collected over 80 varieties of sweet potatoes from different parts of the island, and is now determining the comparative value of each.

During the early years of the Agricultural Station at Santiago de las Vegas, a great number of varieties of maize from all parts of the United States and Mexico were tested, but none proved to be well adapted to Cuban conditions. The common variety cultivated in the island was originally of a yellow flint type; the ears are unusually heavily protected with husks that completely close at the tip, and the husks, leaves and stalks are tomentose; this seems to protect the young leaves from the attacks of numerous small insects which are always seen working about them. The heavy husks protect the ears from the attacks of the corn weevil until the next planting season. The absence of glabrous varieties is apparently due to the work of small insects. Some of the dent maize imported into Cuba has occasionally been planted and has fertilised plants of the native variety, giving rise to acclimatised hybrids. At the Santiago Experiment Station, they have begun to select the best of these, in the hope of fixing a type with long ears enclosed in heavy husks.—BULL. INTERNAT. INST. OF AGRIC.

AGRICULTURE IN PAPUA.

The area planted during the year under review* was 1,527 acres as against 7,558 acres for the previous year. The great majority of the agricultral leases have now been planted up sufficiently to comply with the improvement conditions for the first ten years. The security of tenure having thus been achieved, the inflow of plantation capital, except for maintenance, has, for the present, largely ceased, nor are many new plantation areas likely to be opened up during the currency of the war. The annual cost of maintaining the present plantations is probably over £100,000 a year.

The total area of leases granted for agricultural purposes is 210,613 acres. The lessee is allowed two years from the granting of the lease before starting improvements, and, at the end of five years, one-fifth of the cultivatable area must be planted. Assuming, therefore, that no areas have been planted, on leases that have been granted for a period not exceeding two years, the area of agricultural leases upon which improvements must be effected (i.e., those granted up to 30th June, 1913) is 184,918 acres. The total area planted (including a few freeholds) is 44,447 acres, showing that in the aggregate more than one-fifth of the agricultural leases, whose tenure exceeds two years, have been planted up. The improvement conditions have, therefore, on the whole, been fully complied with up to the present.

It is believed, as the result of a rough estimate, that over £1,000,000 sterling have been expended in plantations in this Territory. With the exception of two large British companies, practically the whole of this capital has been provided from Australia and locally.

The plantations give every promise of success. Those that I have seen lately will, I believe, compare very favourably with any of the plantations in the East. The principal cultivations are coconuts, para rubber and sisal hemp, and I feel confident that, with few exceptions, all the plantations in the Territory will pay good dividends when in full bearing. Rubber areas tapped last year gave 1½ lb. per tree per year, which, for young trees, is very satisfactory. It is reassuring, therefore, to reflect that the large amount of Australian and British capital that has been laid out in agriculture in this Territory has been safely spent, and is likely in a few years to prove a remunerative investment.

* 1914-15.

PLANTATION STATISTICS.

Division.	Coconuts.	Rubber.	Hemp.
Central ...	12,849	5,012	4,159
Eastern ...	13,364	887	85
South-Eastern ...	3,932	2	...
Kumusi ...	340	5	...
North-Eastern ...	798	250	...
Gulf ...	696	...	...
Western ...	608	47	...
Mambare ...	1	...	...
Delta ...	124	...	...
Total...	32,712 acres.	6,203 acres.	4,244 acres.

—ANNUAL REPORT.

CARBOHYDRATE TRANSFORMATIONS IN SWEET POTATOES.

It has previously been noted that the sugar content of sweet potatoes remains comparatively low while they are in the ground, but that immediately after the roots are harvested, there is a transformation of starch into sugar which takes place more rapidly at that time than at subsequent periods. This sugar formation thus appears to be a phase of the carbohydrate metabolism of the sweet potato which is initiated under certain special conditions.

Experiments have therefore been carried out to investigate this process more fully. Determinations were made of the carbohydrate transformations taking place during a period of 10 or 12 days immediately after unearthing the potatoes and at a second subsequent period. The potatoes were kept at temperatures of 30°, 15·5° and 5° C.

The rate of starch conversion was found to vary with the temperature and at 15·5° to 30° the process soon approaches its maximum. The rate of accumulation of cane sugar varies with the temperature, being very rapid at 30° during the first 10 days, then rapidly diminishing. At 5°, little cane sugar is produced during the first 10 days, but the rate of accumulation subsequently increases rapidly. The formation of reducing sugar at 30° is sufficiently rapid to provide all that is used in respiration and allow a considerable accumulation, but less than that at 5°. At the lower temperature, there is a marked accumulation of reducing sugar at first which may be followed by a slight subsequent loss. The diminution in the production of reducing sugar during the second period at 5°, notwithstanding the continued conversion of starch, and the large increase in cane sugar during this period, suggests that the excess of reducing sugar is converted into cane sugar. Also, the concentration of reducing sugar always remains comparatively low, even at low temperatures when respiration is reduced to a minimum. It appears therefore, that with the exception of the quantity used for respiration, the reducing sugar is transformed into cane sugar as fast as it is formed from starch. Probably the series of reactions is reversible and the final equilibrium between the starch, reducing sugar and cane sugar depends on the temperature, with the effect that at low temperatures the system permits a greater concentration of sugar than at higher temperatures. This would also account for the rapid transformation immediately after lifting the roots.

The initiation of this transformation coincides with the cessation of the flow of reserve materials from the leaves and occurs in potatoes left in the ground after the haulm has been cut. It is therefore concluded that the activity of the haulm inhibits the conversion of starch to sugar in the growing sweet potato.—BULL. INTERNAT. INST. OF AGRICULTURE.

PRODUCTION AND USES OF INDIAN TURMERIC.

Turmeric *(Curcuma longa)* is regarded by some botanists as a native of India, but the finest qualities were introduced into India from China or Cochin China. The plant is now-a-days extensively cultivated all over India for its rhizomes (root stock). There are two forms, the hard, highly-coloured rhizome used as a yellow dye-stuff and the fairly soft, pale-coloured, edible root that is employed as a condiment.

With regard to commercial qualities an authority says the Chinese, and especially the Formosan, turmeric is considered to be the best, with the Indian produced in Bengal, Pegu, and Madras ranking next. So different are some of the forms of turmeric that it has often been urged they must be produced from botanically distinct varieties. In European trade the China, Madras, Cochin, Bengal and Java grades are recognised. Cochin turmeric is a globular tuber and usually appears on the market cut into slices. It is edible, and is possibly to some extent often *C. angustifolia* (Indian arrowroot) or *C. montana*, rather than *C. longa*.

Some writers state, however, that the special qualities of the dye rhizome are more a question of age than of specific distinctions. If left in the soil for a longer period or if dried and stored for sometime before being used the tubers assume the dye condition. Exports to the United States have been nearly all for use as a dye. Shipments are in two solid forms, either as rhizome "fingers," which are big, hard and heavy pieces of root, or as "bulbs," a small round form. The total exports to the United States from all ports in the Madras Presidency for the six months ended June 30, 1916, were 1,745,924 pounds, valued at $108,733.

CULTIVATION OF TURMERIC IN MADRAS PRESIDENCY.

The districts in the Madras Presidency where turmeric is chiefly cultivated are Erode, Trichinopoly, Karur, Salem, Nellore, Cochin and Cuddapah. The yearly output for the Presidency is estimated roughly at about 3,000 tons, but a good deal of obscurity prevails as to the production and yield of this crop. The returns are given in maunds, a measure that may vary from 82 to 25 pounds; it is often not possible to discover whether the figures refer to dry or green tubers; and, lastly, ignorance prevails regarding the races of plant grown.

In Coimbatore it is said that turmeric is grown with yams, maize, castor, etc., the rhizomes being planted on ridges in June and July and dug up in March and April. As a rule, turmeric is not grown more than once in three years, and is followed by raggi and paddy. The cost of cultivation seems to be about $38 per acre and the yield from 3,000 to 5,000 pounds of prepared turmeric (value $39 to $65) and 6,250 pounds of yams (value about $65). The plant occupies the ground for nearly a year. When prepared as a condiment the root is called, in the vernacular (Tamil), *manjal*, and when prepared as a dye it is *saya manjal*. Turmeric is often planted on land where sugar-cane grew the preceding year, and is deemed an ameliorating crop.

METHODS OF PREPARING THE RHIZOME.

Various systems of preparing the rhizome for the market are practised. In Bengal they are cleaned, stripped of the fibrous roots, and heated gradually

n earthen pots the mouths of which are carefully closed by lids. The rhizomes are thus stewed in their own juice. Afterwards they are dried in the sun for nearly a week, being protected at night from dew. In Madras the rhizomes are boiled in water and dried in the sun. In the Punjab the drying is done by artificial heat.

When intended to be used as a dye the rhizomes are boiled a second time and powdered while still wet, and a decoction is made of this paste with water. Formerly turmeric dye was very largely used in India at marriage ceremonies, but this practice has considerably declined of late. On ceremonial occasions it was also largely employed to rub on the skin and is so used to this day.

USE AS A DYE AND IN MEDICINE AND CHEMISTRY.

The dye attaches itself readily to wool, silk or cotton, and mordants are rarely required. Calcutta dyers, however, obtain a brilliant yellow by mixing turmeric with carbonate of soda. The principal use of turmeric in India at the present day is as an auxiliary to such other dyes as al *(Morinda citrifolia)*, safflower *(Carthamus tinctorius)* and lac *(Tachardia)*, and in the production of shades of green along with indigo. It is still fairly largely employed in calico printing and in colouring native-made paper. In Bengal it is extensively employed in dyeing cotton cloths and toys and other articles of sola pith *(Æschynomene aspera)*. In the United Provinces it is said to be more commonly used as a condiment than as a dye, and is, as a rule, grown along with *Colocasia antiquorum*.

In Europe turmeric is still employed in dyeing compound shades of wool usually in conjunction with orchil (a purple lichen dye from *Rocella tinctoria*) and indigo extract. It is rarely used on silk. In medicine turmeric is employed as an aromatic stimulant, and in chemistry to make turmeric paper, the latter being used as a common test for alkalis, the chemical action of which turns the paper from a yellow colour to brown or red. Turmeric is also said to be employed in the adulteration of mustard and to colour varnishes. The ports to which turmeric is mostly shipped are Marseilles, Genoa, London, New York, aud formerly Hamburg and Trieste. As a rule, turmeric is sold in Europe in powdered form.—Oil Paint and Drug Reporter.

GARDENS IN BURMA.

F. KINGDON WARD.

Although no one loves flowers more than the Burman, even in his own country market gardening is entirely in the hands of foreigners—Chinese, and natives of India.

Thus around Moulmein, at the mouth of the Saleween River, we find hundreds of Chinese gardens, not divided up by white walls with circular openings into a maze of compartments containing ponds full of Lotus, and strictly arranged earthenware pots containing dwarf Azaleas, tangled Peach bushes, or yellow Cymbidiums, such as are the pleasure gardens of China, but market gardens in which flowers and fruits are grown for the bazaars.

No Burmese girl would come out on a holiday without flowers in her hair, a Rose stuck jauntily on one side, or a chain of white buds bound round her brow. Flowers, especially Roses, are placed in bowls in the houses and thousands are sold on the pagoda steps as offerings to Buddha.

ROSES.

Roses flower all the year round in Burma, and a good deal of ground is given over to their cultivation in Moulmein and other big cities. It is such a typically English flower that it seems strange at first sight to find it growing at all in a monsoon climate at sea level, fourteen degrees north of the equator; but wild Roses are far more plentiful in the mountainous parts of China and Burma than they are in England. Still, it is strange to see them blooming all through the year in a country where we are treated to 160 inches of rain in six months, and to drought for the other six months. True, people at home might not think much of a Moulmein rose, but nothing out here reminds me so much of England as to see baskets of these pink Roses being carried to market every morning on the heads of Burmese girls, or to walk amongst the flower stalls of the big bazaar.

The flowers are generally pink and almost scentless, sometimes deep red and scented, or white, or yellow; but the pink are by far the commonest, and the best blooms. The bushes are about two feet high, never pruned, manured, or grafted, but go on unfurling bloom after bloom throughout the year; the soil is a sticky laterite clay, or sometimes pure laterite.

Acres of garden land are given over to the cultivation of the twining Piper Betle, the leaves of which are chewed with lime and betel nut (*Areca catechu*) by the natives. It is a popular saying that you cannot learn to speak Burmese properly till you can chew betel, but it does not seem a pleasant habit to the Englishman. Every day hundreds of fresh leaves are carried down to the bazaars and sold. I have seen the plant growing wild away upon the eastern branch of the Irrawaddy, where the Marus used to climb the trees for it, chewing, not only the leaves, but the berries as well.

RUBBER.

One would hardly have thought it worth while to plant an acre or two of rubber, but that is what the Chinese do in Moulmein; the trees seem to be left very much to their own devices, but they do well enough. Further south, in the Mergui district, there are several large European estates. Once upon a time the Kachins of far northern Burma used to collect wild rubber, but the trees seem to have been exhausted, and probably almost exterminated by indiscriminate tapping, though I have seen a few, covered with *dah* wounds criss-crossing all the way up the branches, in the Kachin Hills. Market vegetables are grown in much smaller quantity than any of the above —Cabbages in the spring, Sweet Potatoes, Runner Beans, Ginger, and Arrow-root in the summer; small, prickly or warty Cucumbers are also popular, and several Burmese delicacies are grown.

TROPICAL FRUITS.

Certain popular beliefs, however often contradicted, never seem to die, and one such belief is that tropical fruits are incomparable. If you ask, *what* tropical fruits? you may be told the Mango, and that is as far as the average man gets. Certainly a Mango is as luscious and well flavoured as a Strawberry—it is not better. A Mangosteen is the equal of an Orange, but not superior to it, and, beside these two, there are only the Durian, barred to most on account of its vile smell; the Papaya; the Banana, invaluable as a food, but not particularly delectable; the Pine-apple; and the green Coconut, filled with milk enclosed in a soft, white shell, dug out with a spoon like blancmange, thirst quenching, but not inspiring. Against these we have the Strawberry, Mulberry, Cherry, Apple, Pear, Peach, Apricot, Greengage, Plum, and Gooseberry; and if to these we add the Grape, Date, Fig, and Orange from the Mediterranean, the old world tropics at least are out of the running.

Mangoes are grown all down the Tenasserin coast, and the small green fruits, though not so large, are quite as good as the big grafted ones from Southern India and elsewhere.

Pine-apples one finds growing in the hedges round Moulmein, absolutely uncared for, though they are taken to the bazaar. They are cultivated by the Chinese all down the Tenasserin coast, where they do well ; in Victoria Point (the southernmost cape of Burma) they cost from two to four annas (pence) each.

Papayas are commonly grown. Betel palms are, of course, universally grown, and form a conspicuous feature of the country round Moulmein.

The best Mangosteens come from further south, but are to be bought cheaply enough in the Moulmein bazaars, though half of them are bad, due to careless handling and bruising. Wild Mangosteens are to be found on the N.E. frontier at least as far north as 26°, where I picked up some excellent fruit in the valley of the eastern Irrawaddy, a thousand miles north of Moulmein.

The ubiquitous Coconut Palm is grown along the coast, and in the autumn there are Limes and Oranges. Most tropical fruits have a very brief season, which is further evidence of the superiority of our own.

Besides Roses, no other flowers are cultivated on a large scale, not because they are the only ones in demand, but because there are plenty of wild ones ; for instance, the Padouk (*Pterocarpus sp.*) another great favourite with the Burmans. It is said in Burma that the Padouk, which usually bursts into flower at the end of the hot weather (April) must flower three times before the rains. It bursts into full bloom in a single night, scenting the whole place with its long, hanging panicles of golden flowers, and raining gold dust on the wind. Then the Burmans come and break off whole branches recklessly, and carry the flowers to the pagoda, or wear them in their jet black hair. But, as with tropical fruits, so with tropical flowers.

TROPICAL FLOWERS.

It is true that the Goldmohur tree, the Padouk, or a tree draped with *Congea tomentosa*, to mention a few of the chief glories of Burma, are extraordinarily beautiful, but the setting is nearly always poor ; I say nothing of western China, which is not tropical, nor of laid-out botanical gardens, such as those of Buitenzorg, Peradeniya, or Singapore. I am talking of ordinary tropical scenes, and where can one find anything to compare with a Surrey wood sheeted with Bluebells, a Kent Hazel copse in a spring full of Wood Anemones and Primroses, an East Anglian cornfield scarlet with Poppies, or a Scotch moor purple with heather dabbled with golden Gorse? Not in the eastern tropics, not even in the Indies themselves !

Yet people, realising the luxuriance and variety of tropical vegetation, continue to add an imaginary beauty of flower and lusciousness of fruit, never thinking of the gloom of endless Mangrove swamp, the deadly monotony of Bamboo jungle, or the total absence of anything that may be beautiful, once inside the rain forest.

Those who long to see the tropics and cannot, may console themselves with the fact that it is much more romantic to read about than to live in them ; their dreams will far surpass actuality—why shatter them ? How we long to taste English fruit, and see an English garden again.—GARDENERS' CHRONICLE.

WEIGHTS AND MEASURES REFORM.

No better opportunity than the present may occur for a century for carrying out the reform of our troublesome and hopelessly unpractical weights and measures by the adoption of the metric system. Considerable numbers of this country's workers are now in France, where they will make practical acquaintance with the modern system. Many factories and businesses will have to be reformed and reconstructed after the war on such a scale that the adoption of different weights and measures would be only one of many fundamental changes. Most important of all, it will be necessary for us to remove every handicap such as our cumbersome and old-fashioned system if we are to resume our high position in foreign trade. There is probably no considerable body of opinion adverse to the reform in theory, and the practical difficulties are not so great as at first sight they may appear. In 1904 a Bill was passed by the House of Lords to render compulsory in Great Britain and Ireland the use of metric weights and measures, but it failed to pass the House of Commons. The chief reasons urged against it were the cost and inconvenience of making the change. General ideas, not based on definite estimates, of the cost are probably exaggerated. By some large engineering firms, for instance, the opinion is held that the cost would be insignificant and speedily recovered by the saving in clerical work. In some important manufactories the metric system has been in use for years. Little opposition is to be expected from professional men; engineers, civil, mechanical, and electrical, have already recorded their advocacy of the reform. Merchants and brokers stand to gain considerably by saving in clerical work. Probably the greatest expense would be incurred by textile manufacturers, whose strongest argument is that in some continental factories the English textile standards for counts of yarn are still used; proposals for altering these to the metric system are, however, frequently made, and it seems likely that the change will be made before long in those factories, whether this country moves with the times or not. Opposition would be expected from retail traders on account of the cost, but this could be overcome by allowing a period of a year or two for the change to become effective. Scales would be retained; weights alone would have to be altered, and no doubt enterprising firms would undertake the recasting and conversion of existing weights at a small cost to the shopkeeper and small trader. Steel yards would only require re-marking. Measures used in the liquor trade are nowadays largely of glass and are constantly being renewed in any case; milk measures could be easily altered. Measures of length, as used, for example, in the drapery trade, could be converted at an infinitesimal cost. If it is admitted that such a change would be generally advantageous to the country and its trade and industry, and this can hardly be denied, the reform should be carried out, notwithstanding the trifling expenses and inconvenience which individuals will be called upon to bear. Experience shows that in carrying out an advantageous reform the trouble involved is speedily forgotten when the benefit is realised. Those who desire to take an active part in promoting this reform should communicate with the Decimal Association, Finsbury-court, London, E.C.—CHAMBER OF COMMERCE JOURNAL.

THE EFFECTS OF TILLAGE.

It may be convenient at this stage to remark that the effects upon the soil of cultivation are numerous and complex, but they are also of such importance that the vegetable grower should acquire at least a general impression of what they are, and of their close relation to the success of any agricultural or horticultural enterprise.

Left to itself, land usually produces abundantly if the rainfall is a fair one, but the vegetation is not of the class that is desired by the civilised man, and it is therefore the first business of the grower to destroy the class of vegetation the soil would naturally produce, and to make it the means by which more desirable plants can be raised. The initial object of ploughing, therefore, is to destroy that which is already growing upon the land, and to turn it under so that it will be out of the way of subsequent operations. Its decay in that position will improve the physical qualities of the soil, and will provide the crops with plant food.

It is one object of ploughing that it will be possible at a later stage to reduce the surface soil to a fine tilth by the use of harrow and cultivator, and it sometimes happens, especially on new land, that though that which previously grew on the surface has been effectively turned under, the finer implements cannot be employed until a second ploughing at right angles to the first has been given. A fine seed-bed, prepared in a cheap and effective way, must ever be kept in view as one of the objects of tillage.

MOISTURE.

Another effect of ploughing is to enable moisture, whether supplied naturally or artificially, to sink through the surface soil into the subsoil where it may remain for a considerable time, whereas on unploughed land a large proportion must either run off or be dried up by sun and wind before it can sink into the subsoil. Soils vary much in their capacity to hold moisture while yet remaining arable and in good physical condition, and on the other hand plants also show a considerable range of adaptability. It is possible for a soil to contain from 20 to 25 per cent. of water and yet not be too moist for cultivation, while on the other hand plants are able to maintain themselves and grow when the soil contains only 6 to 8 per cent. of moisture.

DEEP CULTIVATION.

The storage capacity of a soil is so much increased by deep cultivation, that this becomes one of the chief reasons for subsoiling. If a heavy rain falls on land that has only been worked 4 inches deep the tilled soil is in danger of being water-logged. On the other hand, land that has been worked to a depth of 12 inches can absorb a much larger rainfall without becoming too wet, simply because the deep working has provided such a large quantity of loose friable soil to take up the moisture. Just as a large sponge will hold more water than a small one, so a big bulk of tilled earth will hold more water than a small bulk of it. One effect is that the surface of the deeply worked soil can be loosened sooner after rain. Moreover, the disadvantages of shallow ploughing are increased by the readier loss of moisture, partly because so much is retained near the surface within reach of sun and wind, and partly because in most situations the surplus can escape so much more easily by run-off or gravitation. How much more quickly the crop will feel the effect of dry weather when the ploughing has been shallow, is apparent.

The deep breaking-up recommended a few paragraphs back thus has a close connection with the retention of moisture.

SOIL AIR.

Yet another effect of cultivation of the soil is the admission of air. Unlikely as it may appear, air is as essential to fertility as water. If a soil is compact, or if its interstices are filled with water or with fine silt, it cannot contain the air that the roots of plants require, and that is necessary to the minute organisms, called soil bacteria, that play an important part in the preparation of plant food. Moreover, it is possible for there to be too much air near the surface and too little below, with the result that while seed may germinate satisfactorily the plants may not do as well as they should when

the roots strike downwards. Cultivation aerates the soil, but it must be carried deep enough for the plant roots to get all the air they require.

TEMPERATURE.

The disturbance of the soil, too, has some effect upon its temperature. If the connection of the surface soil with that just below is interrupted by the plough or other implement, the great heat of the sun in summer, for instance, cannot be so readily communicated to deeper levels. The most important action in this connection, however, is the improvement in soil temperature in spring as a result of cultivation. A soil saturated by winter rains will be kept cold in spring by the rise to the service of the water stored below; cultivation, however, will break the connection as just stated, and prevent the rise of the water, so that the surface soil will dry to a certain extent, and be the more quickly warmed by the action of the sun. The value of this where early, quickly grown, spring vegetables are desired for the market needs only to be indicated.

Before leaving this issue of the importance of deep and thorough preparation of the land, it is not out of place to remark that there are soils that are of such close texture that water passes very slowly through them. To have water standing thus upon the land is clearly unfavourable—it literally "drowns," or threatens to drown, the plants and the soil bacteria—and, if it is at all possible to avoid them, areas that have such deficient natural drainage should not be used for vegetables. In fact, with such extensive areas, suitable in most other respects, as we have in New South Wales it is unlikely that swampy lands will require to be handled for a considerable time. Where, however, the condition has to be dealt with, only deep, open, or underground drains can be recommended. Their effect is to carry off the surplus water, to permit air to pass through the interstices of the soil, and to facilitate the drying up of some of the excessive moisture.

HARD-PAN.

An unsatisfactory condition can be set up in some soils by constant ploughing at the same depth, the result being the formation of what is called a hard-pan which is a band or thin layer of soil that has become so compacted that moisture passes too slowly through it (both downward and upward), and through which the roots of many plants strike with difficulty. In some districts the effect of hard-pan is to produce a condition much resembling that just described as needing drainage. Needless to say, all that is required in such a case is that the plough be set an inch or so deeper, so as to break up the solidified layer, and thereafter regularly to alter the depth of ploughing each year, going sometimes slightly deeper, and sometimes slightly shallower than what is deemed a desirable mean.

SURFACE CULTIVATION.

In addition to the deep cultivation so far kept in mind, it may be pointed out that the moving of the top inch or two of soil has also important functions. Generally speaking, surface cultivation is carried out in gardens for the purpose of destroying weeds, but it also tends to conserve moisture—indeed, so valuable and appreciable are its effects in this direction that, even in the absence of weeds, the surface must be kept in a loose and friable condition.

Exhaustive experiments have proved, that to disturb the top soil prevents moisture from rising to the surface, where sun and wind can carry it off by the process of evaporation. The effect of neglecting the surface in summer, in fact, is simply to allow the moisture (so precious at that time of the year) to escape into the air, and the only convenient way of preventing that is to maintain a dry, loose surface, freshening it every time rain, irrigating or tramping sets it down again. The top 12 or 18 inches of soil are the most important to plant life, but beneath that is usually stored a reserve of water

which is conducted to the surface by fine capillary tubes. Once the connection between subsoil and surface is established, and capillary action can proceed freely, the moisture below will rise steadily to the surface, where it will pass off into the air. The gardener who wishes to be successful must register a resolution, that so far as his property is concerned, compacted and neglected surfaces shall not be tolerated—that, in other words, loss of moisture by capillarity and evaporation shall be reduced to a minimum.

MULCH.

While a soil mulch is perhaps the most convenient method of preventing evaporation, stable manure and straw are also largely used for the purpose, their effect being to prevent the sun and wind from too close contact with the soil surface. In raised beds, where it is often difficult to maintain the sides in a loose condition without constant washing down, the sides should be covered with some mulching material in order to prevent loss of moisture.

The only time when the gardener should excuse in his own mind any loss of moisture, is in the germination of fine seeds. It is then necessary, in order to obtain a good percentage of germination, to bring the soil to a fine tilth, and to roll it after sowing the seed. This brings the moisture to the surface, by consolidating the soil so that the capillary movement of the subsoil moisture is set up; germination is thus ensured. But even in such cases the surface should be broken as soon as the plants are established. In the case of seeds (such as onions, etc.) sown by a hand seed-sower, the rolled portion between the rows should be disturbed immediately after sowing.—Agric. Gazette of N. S. W.

PLANT PROPAGATION INSTRUCTION.

A valuable handbook, by Mr. P. J. Wester, Horticulturist in charge of the Lamao Experiment Station in the Philippines, has been issued by the Director of Agriculture as Bulletin No. 32 of the Bureau of Agriculture. This publication will be found of much interest and use by agricultural officers and planters. The Bulletin deals with plant propagation in all its practical aspects. The contents consist almost entirely of practical instructions so that a summary of the information is almost impossible; a brief survey of the chief subjects dealt with, however, may serve a useful purpose.

These include an account of plant and propagation sheds, nursery accessories, the propagation from seed and the rearing of stock plants, propagation by budding, propagation by layering and marcottage, propagation by graftage, brief directions for the vegetative propagation of tropical and semi-tropical fruits, brief directions for tree planting and orchard management, an account of shade trees and ornamental plants, diseases and insect pests, spraying and formulas for fungicides and insecticides, lists of tropical fruits in the Philippines, tables showing distances for planting, tables showing the number of plants, set at given distances, required for one hectare, and lastly, tables of weights and measures.

In dealing with the principles of plant propagation it is stated that "Plants perpetuate and reproduce themselves by means of two methods: (*a*) sexually, or from seeds or spores, which is the method most commonly employed by plants in their wild state, and (*b*) asexually or vegetatively, when reproduction is effected without the aid of generative organs of the plants, or by the propagation of a growing or vegetative part, such as (1) by means of runners above the ground, as for instance the strawberry; (2) by underground runners, commonly called ratoons, as in several species of grasses, the pine-apple, etc.; (3) by tubers, bulbs, or rootstocks, as for instance the yautia or gabe, and the banana; (4) by stolons, such as certain

grasses, *Chlorophylum elatum*, etc.; (5) by aerial bulblets, produced in the axils of the leaves, as in the several species of Dioscorea, or as in the sisal hemp plant in the flower stalks; in the pine-apple the bulblets grow out among the leaf scales immediately under the fruit, when they are commonly called slips; (6) by roots like the sweet potato; (7) by the formation of germinative tissue, such as in certain tubers of the genus Dioscorea or in the leaves of the Begonia. These are natural means of propagation.

In the section giving brief directions for the vegetative propagation of tropical and semi-tropical plants, the following notes are extracted as being of interest and instructive :—

Avocado, *Persea americana*. Use tender to mature, but green smooth, petioled budwood; cut the buds 3·5 to 4·5 centimetres long; age of stock at point of insertion of bud unimportant.

Cacao, *Theobroma cacao*. Use non-petioled, matured, brownish or grayish budwood that has been of slow formation, of current or last year's growth; cut the buds 4 to 5 centimetres long; insert in stock at a point approximately the same age and appearance as the scion.

Camia, *Averrhoa Carambola*. Use non-petioled, fairly mature brownish or grayish, still-downy budwood; cut the buds 3·5 to 4·5 centimetres long; age of stock at point of insertion of bud unimportant.

Cashew, *Anacardium occidentale*. Use non-petioled mature budwood which is turning grayish; cut the bud 4 to 4·5 centimetres long; insert the bud in stock at a point of approximately the same age and appearance as the scion.

Coffee, *Coffea* spp. Propagated by cleft grafting in Java. The scions are made from upright growths, not the branches, in order to produce trees of normal growth, well-matured, green and smooth, 5 to 7·5 centimetres long and inserted in the stock where it is already brownish and rough 15 to 25 centimetres above the ground; tied with unwaxed tape and narrow glass tubes placed over the grafted plant to prevent entrance of rain-water into graft. Excelsa, Liberian and Abeocuta coffee are considered the best stocks.

Experiments under way at Lamao Experiment Station indicate that shield budding will be successful if mature, green, smooth non-petioled buds are used, and are entirely covered with waxed tape.

Lime, *Citrus limetta*. See Orange. Congenial stocks are sour orange, orange, rough lemon, pomelo, calamondin.

Mango, *Mangifera indica*. Use non-petioled, mature smooth green budwood from the first, second or third flush; cut the buds 4 to 4·5 centimetres long; with ample woodshield; insert the buds in stock at a point approximately of the same age and appearance as the scion.

Orange, *Citrus aurantium*. Use fairly to well-matured petioled, green and smooth perfectly spineless and round budwood; cut the buds 2·5 to 4 centimetres long; age of stock at point of insertion of bud unimportant. Congenial stocks are : sour orange, rough lemon, pomelo, lime, calamondin.

Papaya, *Carica Papaya*. Propagated by cleft grafting and side grafting. Make grafts preferably not more than 10 centimetres aboveground, in stocks preferably 20 to 30, not more than 50 centimetres high, or more than 2·5 centimetres in diameter at point of union; in the cleft graft, if there is any considerable hollow in stock, make the cleft to one side of it; in the side graft make the incision entirely outside of the hollow; make scions from sprouts about 7 centimetres long of old papayas; trim off nearly all leaf blades, leaving the petioles. Perform work late in the afternoon and keep plants shaded.

Tamarind, *Tamarindus indica*. Use petioled, well-matured brownish or grayish budwood, cut the buds 3 centimetres long; age of stock at point of insertion of bud unimportant.—The Agricultural News.

THE VALUE OF *SACCHARUM SPONTANEUM* IN BINDING MOVING SANDS IN SICILY.

A. BORZI.

The chief object of this article is to draw the attention of the cultivator to certain species of Gramineæ which experience has shown to be very useful in the improvement of the condition of the sands of the coast in some parts of Sicily; this is done by listing the characteristics of these plants from cultural and biological stand-points, and showing how they may be more widely used.

Amongst these Gramineæ, the first place for utility in binding together the sands of the southern districts belongs to *Saccharum spontaneum* L. (= *Saccharum Ægypticum* Wild.) which perhaps represents the original wild form of the sugar-cane. On the north coast, and at some places on the east and south coasts of Sicily, *S. spontaneum* is often found, usually cultivated, but sometimes having reverted to a wild state. It provides a shelter for the fields and kitchen gardens against the sea winds. Its cultivation dates back several centuries, especially in the country round Messina, where the plant was probably introduced from Egypt. *S. spontaneum* is a perennial growing throughout the year ; its stems attain a height of 4·92 ft. or with its leaves, of over 9·84 ft., while in garden soil its roots are usually no longer than 11·7 in., but in loose sandy soil they can attain a length of 6·56 - 9·84 ft. In garden soil, the radius of the rhizomes never exceeds 11·7 in. in one year, but in sand they can grow to a length of 8·2 ft. so as to occupy an area of 23·839 sq. yds. and more ; this plant, therefore, spreads considerably over the sands.

Owing to the combined effects of the torrents and the sea, the northern coast of Sicily is continually extending, so that in periods varying from 10 to 20 years, according to the locality, a strip of an average width of 82 ft. requires reclaiming. After marking out the area to be reclaimed *S. spontaneum* is planted in lines perpendicular to the direction of the prevailing winds. The planting is effected in the cool season (from Autumn till April), by means of pieces of cane from 13·65 in. to 15·6 in. in length, with 2 to 4 nodes. The small canes are planted 11·7 in. deep and from 7·8 in. to 11·7 in. apart, in squares. The sand driven by the wind is held up by the plants which quickly take root and grow rapidly. A dyke is thus made that attains its full height (as much as 4·92 ft.) in from 3 to 4 years, and forms an efficient and permanent protection for the land behind it, which is usually devoted to vine-growing.

In order to make this protection more certain and to permanently prevent the surface of the dyke being disturbed by the winds on the interior slope, plantations are made of *Opuntia amyclæa* and *Agave americana* on the landward slope. This is often unnecessary, as the surface becomes covered naturally by different wild plants, the most common being *Cynodon dactylon*, *Panicum repens*, *Dactyloctenium Ægyptiacum*, *Andropogon hirtum*, *Medicago marina*, *Lotus cytisoides*, *Eryngium maritimum*, *Paronychia argentea*, etc. Of these plants, *C. dactylon* is the one which is most adapted for binding the soil together.—Bull. Internat. Inst. of Agric.

[*Saccharum spontaneum* is found in Ceylon; *Cynodon dactylon* is the well-known Doob grass ; and *Panicum repens* is the common Etora.—Ed. T. A.]

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Soccotrine cwt.	Fair to fine	100/ a 110/
Zanzibar & Hepatic „	Common to good	60/ a 100
ARROWROOT (Natal) lb.	Fair to fine	3½d a 4d
BEES' WAX cwt.		
Zanzibar Yellow „	Slightly drossy to fair	£7 12/6 a £8
East Indian bleached „	Fair to good	£8 10/ a £8 12 6
„ unbleached „	Dark to good genuine	£6 5/ a £6 17/6
Madagascar „	Dark to good palish	£7 5/ a £8
CAMPHOR, Japan lb.	Refined	2 9 a 2/10
China cwt.	Fair average quality	150/
CARDAMOMS, Tuticorin	Good to fine bold	3/6 a 4/6
per lb.	Middling lean	2/ a 2/9
Malabar, Tellicherry „	Good to fine bold	3/6 a 4/6
Calicut „	Brownish	2/ a 3/
Mangalore „	Med Brown to good bold	3/ a 5/10
Ceylon, Mysore „	Small fair to fine plump	1/8 a 5/6
Malabar „	Fair to good	1/7 a 1/8
Seeds, E. I & Ceylon „	Fair to good	1/7 a 1/8
Ceylon "Long Wild" „	Shelly to good	1/ a 1/6 nom.
CHILLIES, Zanzibar cwt.	Dull to fine bright	100/ a 110/
Japan „	Fair bright small	80/ a 89/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1⅜d a 4½d
	Renewed	3d a 5½d
	Root	1⅜d a 4d
CINNAMON, Ceylon 1sts.	Fair to fine quill	10½d a 1/6
per lb. 2nds.	„ „	9½d a 1/5
3rds.	„ „	8½d a 1/3
4ths.	„ „	7d a 1/
Chips.	Fair to fine bold	3d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1/1
Amboyna „	Dull to fine	10½d a 11d
Zanzibar „	Fair and fine bright	7d a 7½d
Madagascar „	Fair	7½d
Stems „	Fair	1⅜d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian „	Fair to bold	„
COCOA, Ceylon Plant. „	Special Marks	85/ a 90/6
	Red to good	78/ a 84/
Native Estate „	Ordinary to red	50/ a 82/
Java and Celebes „	Small to good red	70/ a 98
COLOMBO ROOT „	Middling to good	32/6 a 40/
CROTON SEEDS, sifted „	Dull to fair	42/6 a 47/6
CUBEBS „ „	Ord. stalky to good	160/ a 180/
GINGER, Bengal, rough „	Fair	35/
Calicut, Cut A „	Medium to fine bold	75/ a 85/
B & C „	Small and medium	55/ a 75
Cochin, Rough „	Common to fine bold	40/ a 47/6
	Small and D's	40/
Japan „	Unsplit	38/
GUM Ammoniacum „	Ord. blocky to fair clean	60/s a 85s
Animi, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
„	„ „ little red	£11 a £12
„	Bean and Pea size ditto	70/ a £11
„	Fair to good red sorts	£8 10/ a £10 10
„	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar „	Fair to good palish	£4 a £8
„	„ „ red	£4 a £7
Arabic, E. I. & Aden „	Ordinary to good pale	45/ a 55/ nom.
Turkey sorts „	... ...	57/6 a 60/
Ghatti „	Sorts to fine pale	20/ a 32/6
Kurrachee „	Reddish to good pale	25/ a 35/ nom.
Madras „	Dark to fine pale	20/ a 32/6 nom.
Assafœtida „	Clean fr. to gd. almonds	£15 a £20
	com. stony to good block	£4 a £10
INDIGO, E.I. Bengal lb.	Shipping mid to gd. violet	14/6 a 15/6
„	Consuming mid. to gd.	13 9 a 14/6
	Ordinary to middling	12/6 a 13/6
„	Mid. to good Kurpah	8/9 a 11/
„	Low to ordinary	6 6 a 8 6
„	Mid. to fine Madras	4/6 a 5/6
KAPOK-Ceylon lb.	Ordinary to good	5d a 7d
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	60/ a 70/
Somali „	„ „	50s a 60s
MACE, Bombay & Penang		
per lb.	Pale reddish to fine	1/10 a 2/
	Ordinary to fair	1/8 a 1/9
Java	„ „ good pale	1/8 a 1/10
Bombay	Wild	5d

	QUALITY.	Quotations.
NUTMEGS,— lb.		
Singapore & Penang „	64's to 57's	1/6 a 1/9
	80's	1/1
	110's	11d
NUX VOMICA, Cochin	Ordinary to good	20/ a 23/
per cwt. Bengal	„ „	18/ a 20/
Madras	„ „	18/ a 21/
OIL OF ANISEED lb.	Fair merchantable	3/4½
CASSIA „	According to analysis	3/10 a 4/1
LEMONGRASS oz.	Good flavour & colour	1⅛d
NUTMEG „	Dingy to white	1½d a 1⅞d
CINNAMON „	Ordinary to fair sweet	5d a 1s 6d
CITRONELLE lb.	Bright & good flavour	1/11
OLIBANUM, drop „	Good to fine white	60s a 65s
„	Middling to fair	45s a 50s
pickings „	Low to good pale	20/ a 35/
siftings „	Slightly foul to fine	27/6 s a 35s
ORCHELLA WEED—cwt		
Ceylon „	Fair	10/6
Madagascar „	Fair	10/6
Zanzibar „	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	9½d
Ceylon „ „	Fair to fine bold heavy	8½d a 8½d
Singapore ...	Fair	7⅝d
Acheen & W. C. Penang	Dull to fine	8d a 8½d
(White) Singapore „	Fair to fine	9½d a 10d
Siam „	Fair	9⅜d
Penang „	Fair	9½d
Muntok „	Fair	9⅜d
RHUBARB, Shenzi „	Ordinary to good	1/6 a 3/
Canton „	Ordinary to good	1/3 a 2/3
High Dried „	Fair to fine flat	1/3 a 1/4
RUBBER, INDIA lb.	Standard smoked sheets	2/5¼
Ceylon, Straits, „	Standard Crepe	2/5½
Malay Straits, etc. „	Scrap fair to fine	1/9 a 1/10
Assam „	Fair 11 to ord. red No. 1.	1/6½ a 2/2
Rangoon „	„ „ „	1/7½ a 2/2
Borneo „	Common to good	1/6 a 1/9
Java „	Good to fine red	1/10 a 2/2
Penang „	Low white to prime red	1/6 a 2/
Mozambique „	Fair to fine red ball	1/ a 2/
„	Sausage, fair to good	1/ a 2/
Nyassaland „	Fair to fine ball	1/6 a 2/
Madagascar „	Fr. to fine pinky & white	1/6 a 2/9
„	Majunga & blk coated	1/ a 1/6
„	Niggers, low to good	9d a 1/6
New Guinea „	Ordinary to fine ball	1/6 a 2/
SAGO, PEARL, large—cwt	Fair to fine	24/6 a 25/
medium ...	„ „	24/6 a 25/
small ...	„ „	20/ a 22/
Flour ...	Good pinky to white	16/ a 18/
SEEDLAC cwt.	Ordinary to gd. soluble	90/ a 120/
SENNA, Tinnevelly lb.	Good to fine bold green	10d a 1/
	Fair greenish	6d a 8½d
	Common specky & small	2½d a 5d
SHELLS, M. o' PEARL—	Small to bold	40/ a £5 10/
Egyptian cwt.	„ „	55/ a £5 15/
Bombay „	Chicken to bold	£6 10/ a £10 10/
Mergui „	„ „	£6 a £10 10/
Manilla „	Sorts	40/ a 45/
Banda „	Small to large	50/ a 75/
Green Snail „	Mid to fine bl'k not stony	25 a 26
TAMARINDS, Calcutta...	Inferior to good	Nominal.
per cwt. Madras		
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	10/ a 25/
	Pickings	5/ a 15/
Ceylon	Small to bold	10/ a 20
TURMERIC, Bengal cwt.	Fair	30/ nom.
Madras „	Finger fair to fine bold	30/ a 32 6 nom.
Do. „	Bulbs „ „ bright	23/ nom.
Cochin „	Finger fair	27 6 nom.
	Bulbs „	20/ nom.
VANILLOES— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	7/ a 12/
Madagascar ... } 2nds.	Foxy & reddish 3½a „	7/9 a 8/3
Seychelles ... } 3rds.	Lean and inferior	7/ a 7/6
WAX, Japan, squares, cwt.	Good white hard	63/6

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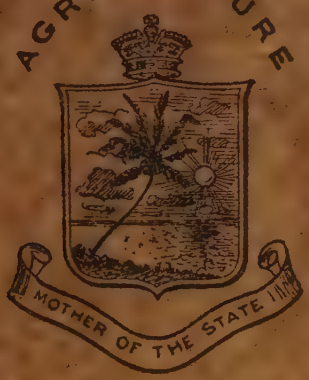

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M. J. A. Karunanayake	Matara	V. Ramanathan ...	Jaffna
A. Madanayake ...	Galle	K. Chinnasamy Pillai	Batticaloa

RULES

OF THE

Agricultural Society of Ceylon.

1. The Society shall be called "THE AGRICULTURAL SOCIETY OF CEYLON."

2. The business of the General Society shall be conducted through the Board of Agriculture of Ceylon.

3. The Board shall meet for despatch of business once a quarter. Seven members shall form a quorum.

4. Notices of motions or questions shall be sent to the Secretary at least one week before the meeting of the Board.

5. All motions will require to be seconded and will be circulated before the Board meets.

6. A General Meeting of the Society may be called by the President at any time and may be held at any place to be fixed by him.

7. All members of the Board will be nominated by the President.

8. Candidates for membership of the Society should where necessary be proposed by a Member of the Board for the district in which the Candidate resides or owns landed property.

9. Members of the Society resident in Ceylon shall pay a subscription of Rs. 10 per annum; Members resident outside Ceylon Rs. 15 inclusive of postage.

10. Payment of the subscription in advance will entitle a Member to receive the publications of the Society. All subscriptions shall be paid to the Secretary of the Board.

11. Lists of Members will be published.

12. Local Societies may be formed with a Membership of not less than twelve Members.

13. Each Local Society should be represented by a Secretary, through whom correspondence with the Board can be conducted.

14. All Local Societies shall be registered at the Local Kachcheri and by the Secretary of the Board.

15. The Revenue Officers of the Province and District shall be *ex-officio* Members of the Local Societies within the Province.

16. Local Societies are empowered to make their own rules.

17. All Local Societies will be entitled to receive all publications of the Society on payment of an individual subscription.

18. The funds of the Agricultural Society will be lodged in a Bank in the name of the Agricultural Society of Ceylon. The Secretary will be responsible for the accounts, and all cheques will be signed by him and the President or a Vice-President of the Board of Agriculture.

19. A statement of Expenditure incurred, &c., shall be tabled at each meeting of the Board.

20. All grants-in-aid of Local Societies or special experiments must be approved by the Board.

21. All accounts will be audited annually.

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